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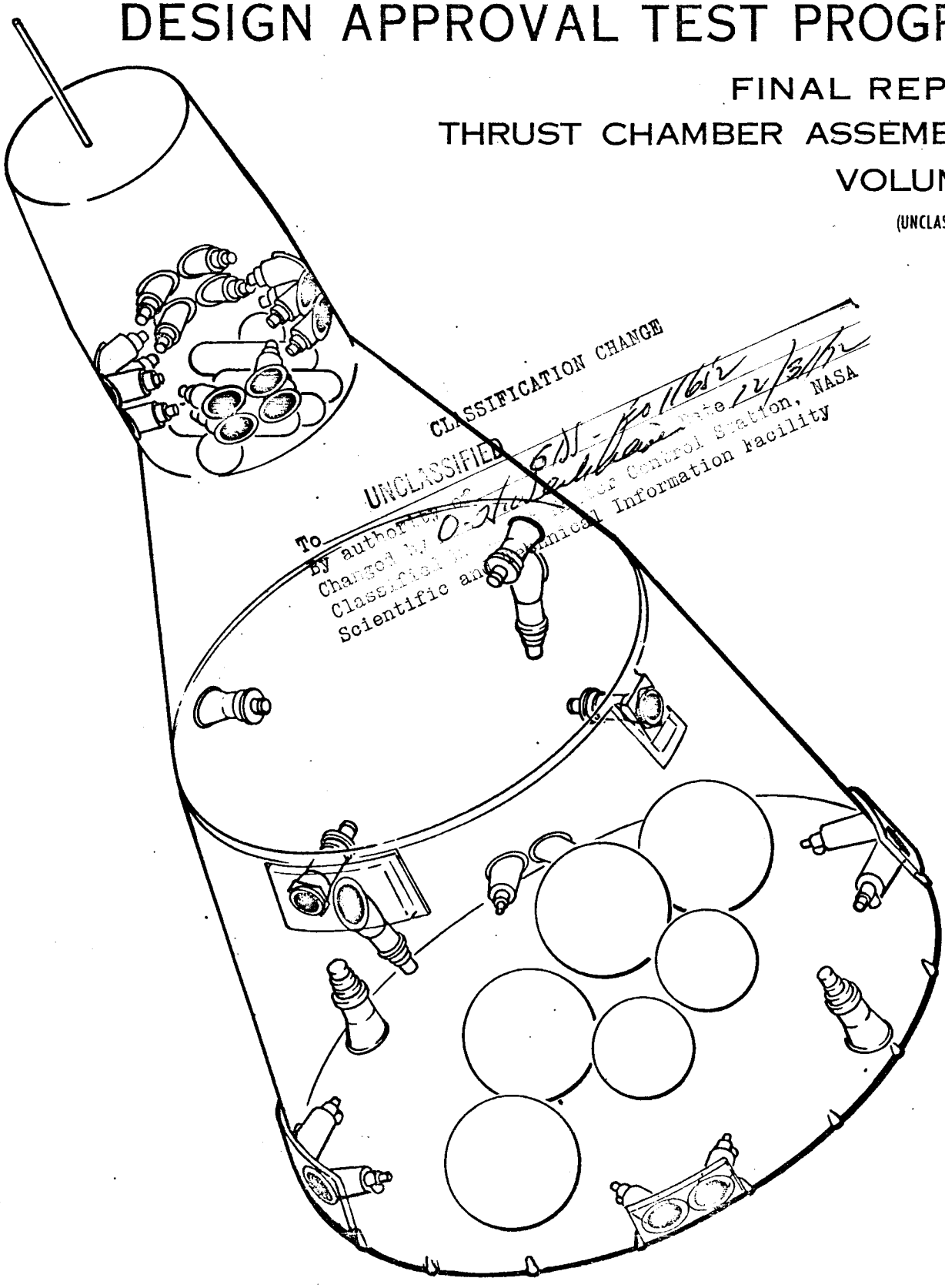
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X70-77609 GEMINI

DESIGN APPROVAL TEST PROGRAM

FINAL REPORT
THRUST CHAMBER ASSEMBLIES
VOLUME II

(UNCLASSIFIED TITLE)



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GEMINI DESIGN APPROVAL TEST PROGRAM FINAL REPORT, THRUST CHAMBER ASSEMBLIES, VOLUME II, BOOK 3 85-POUND-THRUST OAMS TCA P/N 207510-21

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FOREWORD

This report on the Design Approval Testing of the Gemini 85-Pound-Thrust OAMS TCA was prepared for the McDonnell Aircraft Corporation in accordance with the requirements of Purchase Order Y20161R.

ABSTRACT

The Design Approval Test program conducted on the Gemini 85-Pound-Thrust OAMS TCA P/N 207510-21 is described. Test data, photographs of test equipment, and test summaries are included.

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INTRODUCTION AND SUMMARY

The Design Approval Test program for the Gemini 85-Pound-Thrust Orbit Attitude and Maneuver System (OAMS) Thrust Chamber Assembly (TCA) was conducted in compliance with McDonnell Aircraft Corporation Purchase Order Y20161R.

The objective of the Design Approval Test program was to demonstrate compliance of the 85-Pound-Thrust OAMS TCA with the requirements of McDonnell Aircraft Corporation Specification Control Drawing 52-52701 by conducting a series of environmental and operating tests on three TCAs. These three TCAs were designated as Units 1, 2, and 3 for purposes of identification during the DAT program.

Two failures were encountered during the program. During the mission duty cycle test conducted on Unit 2, the throat skin temperature exceeded the allowable specification limits. This failure was reported in OFR 12923R of Appendix B. Testing was continued with the Hot Fire Burst Pressure Test. It was believed that the skin temperature failure would not compromise the burst pressure test and the burst pressure test would not detract from the subsequent skin temperature failure analysis. This judgment was verified by the test results.

During the postpropellant valve service life test on TCA Unit 3, the dielectric strength of the fuel valve was found to be below allowable specification limits. This failure was reported in OFR 12981R of Appendix B. Valve performance degradation as a result of this discrepancy, however, was insignificant and was not apparent during the prior testing. Compliance of the 85-Pound-Thrust OAMS TCA with all specification requirements was adequately demonstrated by this DAT program.

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DESCRIPTION OF 85-POUND-THRUST OAMS THRUST CHAMBER ASSEMBLY P/N 207510-21

The SE-7 85-Pound-Thrust Orbit Attitude and Maneuver System (OAMS) Thrust Chamber Assembly (TCA) is a storable liquid bipropellant, pressure-fed, ablatively-cooled assembly (Fig. 1, 2, and 3). It is used in the Orbit Attitude and Maneuver System for aft translational maneuver control of the Gemini spacecraft. Thrust level and propellant mixture ratio are controlled by fixed orifices located at the propellant valve inlets. The propellants used are nitrogen tetroxide (NTO) as the oxidizer and monomethylhydrazine (MMH) as the fuel.

The thrust chamber core is made in two segments: the combustion zone segment and the nozzle segment. The combustion zone segment is fabricated from 90-degree oriented (perpendicular to the TCA centerline), high silica, resin impregnated ablative material. The nozzle segment is fabricated from 0-degree oriented (parallel to the TCA centerline), high-silica resin impregnated ablative material. The bond line between the combustion chamber segment and the nozzle segment is located in a low-pressure, low-stress area aft of the throat insert.

The thrust chamber body is wrapped with a layer of phenolic bonded asbestos fiber to provide additional heat barrier and sealing capabilities. Structural support for the thrust-chamber body assembly is provided by alternate layers of high-temperature, high-strength glass cloth and filament wound glass roving bonded by phenolic resin. Additional layers of glass roving provide added strength in the injector and throat areas. The thrust chamber body is encased in a stainless-steel shell to provide structural attachment between the thrust chamber and the spacecraft. The combustion

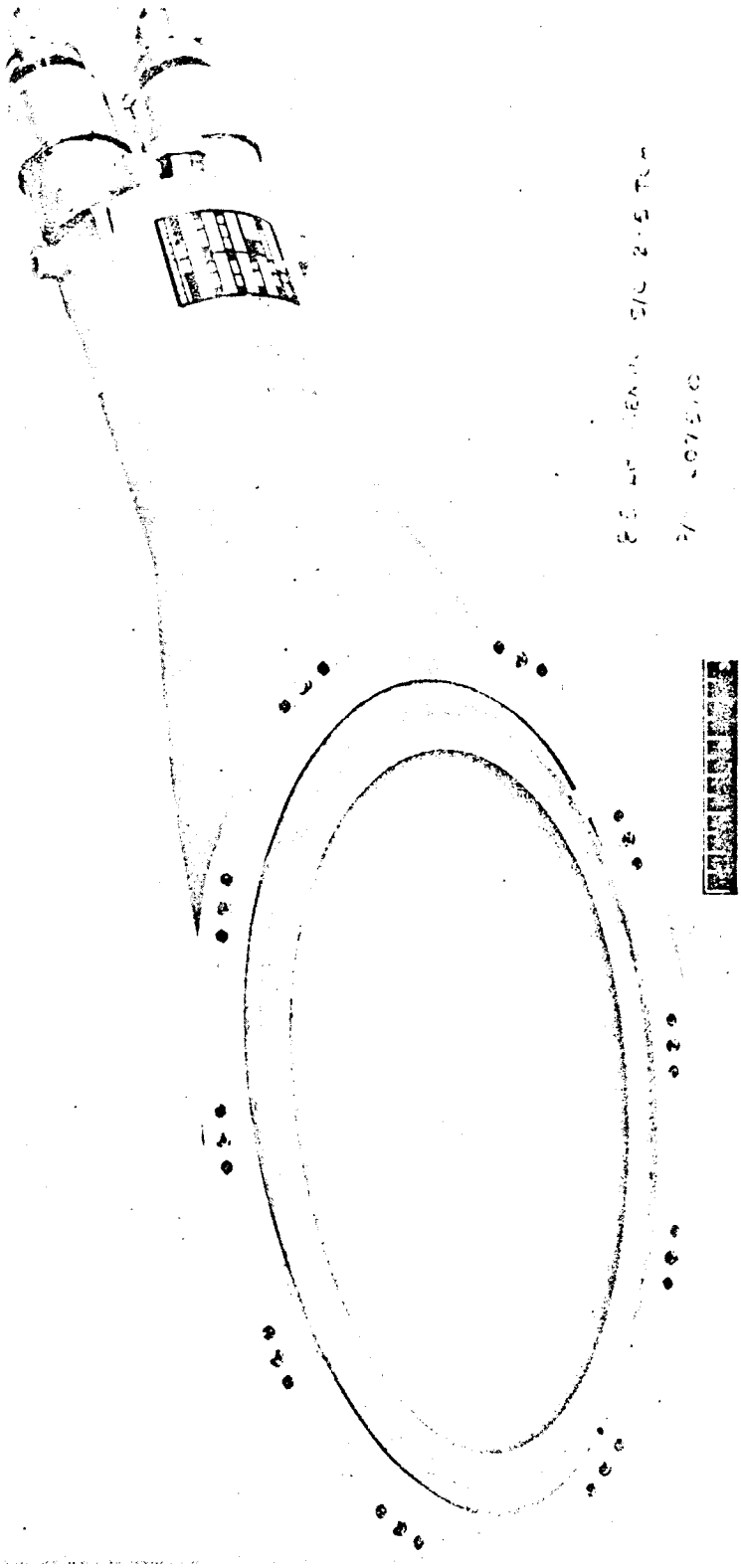
chamber of the TCA contains a 0-degree ablative sleeve and a seven-piece, segmented, JTA graphite liner. A throat insert of solid silicon carbide is used to resist the erosive effects of the high-temperature combustion gases.

The thrust chamber injector is fabricated from corrosion resistant steel. It consists of 16 pairs of unlike doublets which impinge on a splash plate, providing propellant mixing for high combustion efficiency.

Thrust chamber assembly operation is controlled by two fast-acting, electrically operated, solenoid propellant valves. The valves are supported by a mounting bracket, which is in turn attached to the injector plate. The basic propellant-valve design embodies a hermetically sealed solenoid. Valve sealing is accomplished through the use of a precision-ground ball, attached to the armature, which engages a Teflon seat in the closed position. A metal stop below the Teflon seat is incorporated to limit the armature stroke. Closing is accomplished through the use of a spring, and sealing force is obtained from the spring and the pressure of propellant acting on the ball.

The P/N 207510-21 thrust chambers tested were identical to those delivered for flight, with one exception. The configuration tested, P/N 207510-21, did not have the chamber-pressure sensing boss welded closed.

The physical and performance data for the 85-pound-thrust OAMS TCS are presented in Table 1 .



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Figure 1. Gemini 85-Pound-Thrust OAMS TCA, P/N 207510

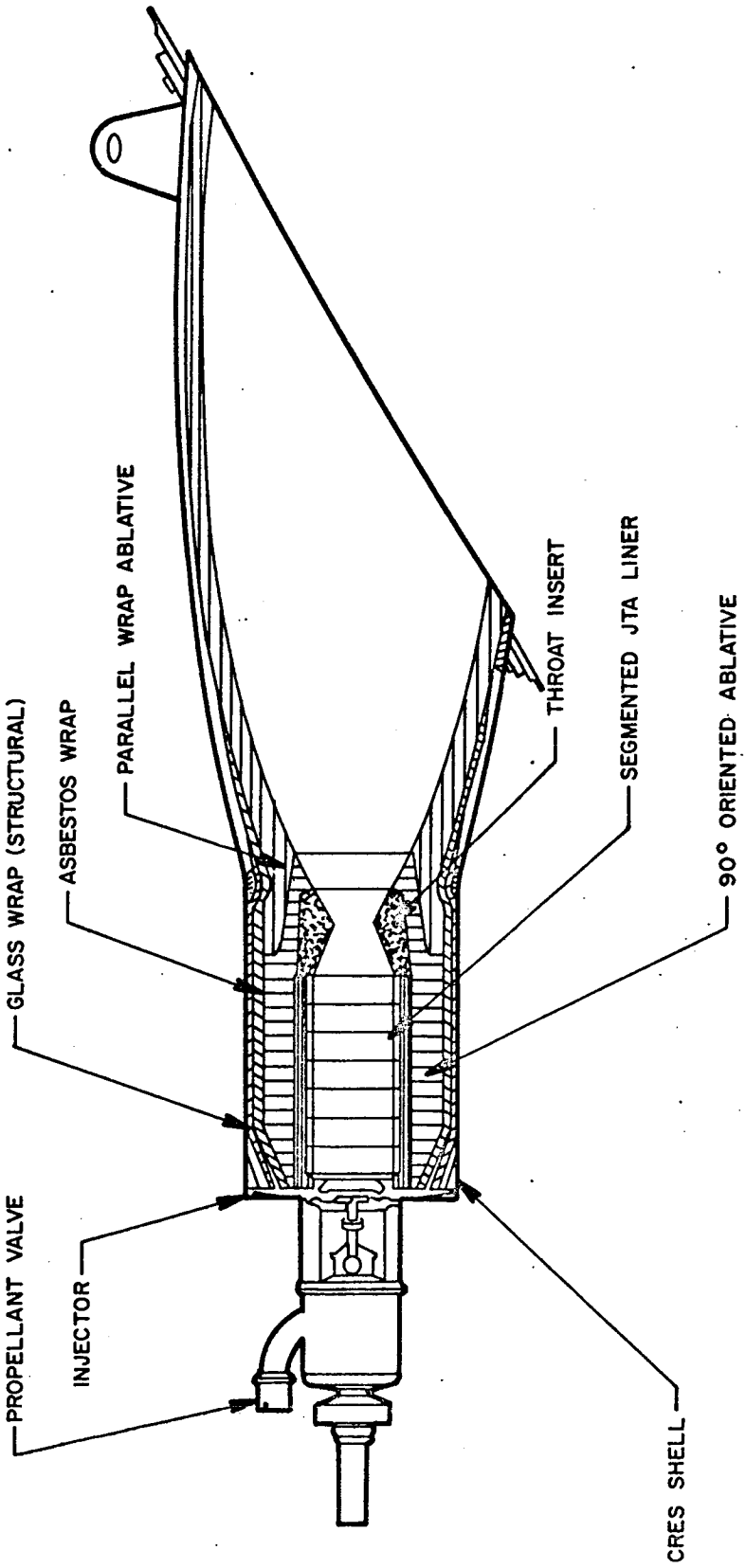


Figure 2. Cross-Sectional View of Gemini 85-Pound-Thrust OAMS TCA

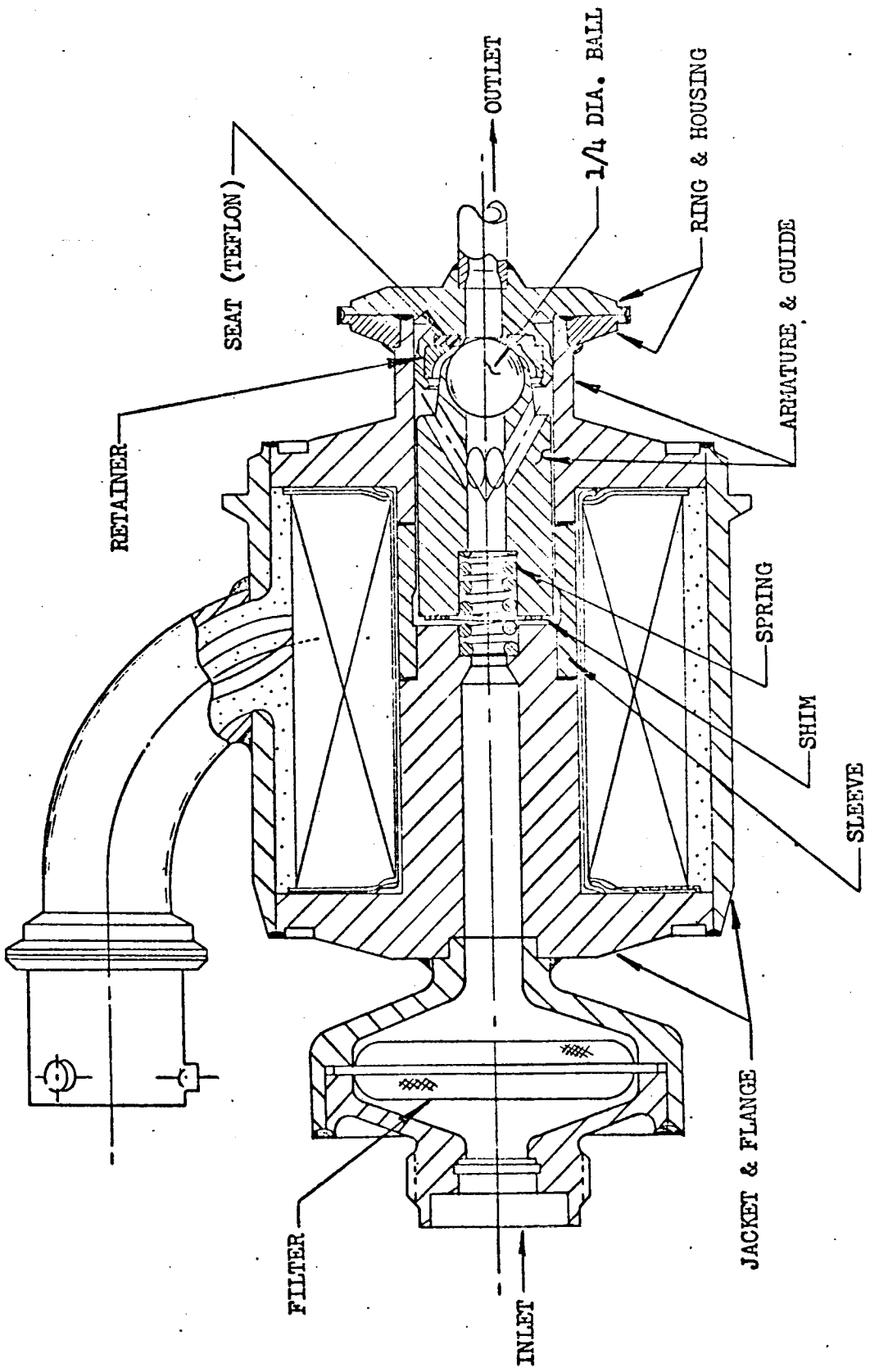


Figure 3. Cross-Sectional View of Gemini OAMS Propellant Valve P/N 407662

TABLE 1

85-POUND-THRUST OAMS TCA P/N 207510-21
PHYSICAL AND PERFORMANCE DATA

Compliance of the Gemini 85-Pound-Thrust OAMS TCA P/N 207510-21 with the following physical and performance requirements has been verified by design approval tests.

Physical Data

Envelope	overall dimensions are: length 22.95 inches, forward OD 3.23 inches, and aft OD 5.5 inches
Weight	8.34 pounds
Compatibility	nitrogen tetroxide and monomethyl-hydrazine

Materials

Valve Parts, Internal Exposed	CRES and Teflon
Injector	type 321 CRES
Thrust Chamber Core	ablative and ceramic
Structural Shell and Brackets	type 321 CRES

Performance Data

Propellants	nitrogen tetroxide and monomethyl-hydrazine
Thrust, Vacuum, Nominal, pounds	79.0
Chamber Pressure, Mean, psia	124.0
Mixture Ratio, Nominal, o/f	1.6
Specific Impulse	classified
Oxidizer, Inlet Pressure, Nominal, psia	283.0

TABLE 1
(Concluded)

Fuel Inlet Pressure, Nominal, psia	286.0
Life, Specification Performance MAC Mission Duty Cycle OCM 217, seconds	147
Life, Guaranteed, MAC Mission Duty Cycle OCM 217, seconds	270
Propellant Valve Service Life, cycles	50,000
Propellant Valve Voltage, Nominal, vdc	26.0
Propellant Valve Current, Nominal, amps	0.619
Start Time, Maximum (On signal to 90 percent of thrust), milliseconds	50
Shutdown Time, Maximum (With spacecraft electrical circuit)(Off signal to 2 percent of thrust), milliseconds	125
Shutdown Impulse (Without spacecraft electrical circuit), pound-second	1.3
Environmental Temperature Range, Operating, F	15 to 200
Environmental Temperature Shock Nonoperating, F	-40 to +185
Vibration Level Random (rms), g	9.6
Shock Level (In shipping container), g/11 millisecond	15
Proof Pressure, psig	480 at 68 F

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TABLE 1*
(Concluded)

Performance	
Specific Impulse, Mean, seconds	296

*Classified parameter

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TEST PROGRAM

TEST OUTLINE

Three thrust chamber assemblies designated Units 1, 2, and 3 were subjected to the following tests in the order listed.

Unit 1

1. Visual Inspection
   a. Component modification
2. Vibration Test
   a. Propellant valve proof pressure and leakage
   b. Thrust chamber proof pressure and leakage
   c. Propellant valve electrical resistance
   d. Propellant valve dielectric strength
   e. Propellant valve functional
   f. Visual inspection
3. Mechanical Shock Test
   a. Propellant valve proof pressure and leakage
   b. Thrust chamber proof pressure and leakage
   c. Propellant valve electrical resistance
   d. Propellant valve dielectric strength

e. Propellant valve functional

f. Visual inspection

4. Temperature Shock Test

a. Propellant valve proof pressure and leakage

b. Thrust chamber proof pressure and leakage

c. Propellant valve electrical resistance

d. Propellant valve dielectric strength

e. Propellant valve functional

5. Mission Duty Cycle to Failure

6. Disassembly and Inspection

Unit 2

1. Visual Inspection

a. Component modification

2. Thrust Vector Test

3. Mission Duty Cycle to 147 Seconds and Burst Pressure Test

4. Disassembly and Inspection

Unit 3

1. Visual Inspection

a. Component modification

2. Thrust Vector Test
3. Mission Duty Cycle to 270 Seconds
4. Propellant Valve Service Life Test
   a. Propellant valve proof pressure and leakage
   b. Propellant valve electrical resistance
   c. Propellant valve dielectric strength
   d. Propellant valve functional
5. Disassembly and Inspection

The test units subjected to testing were identified as Rocketdyne P/N 207510-21 and the Serial Numbers were as follows:

Unit 1	S/N 4051207
Unit 2	S/N 4051206
Unit 3	S/N 4053579

TEST DESCRIPTION AND RESULTS, UNIT 1

VISUAL INSPECTION

Description

Unit 1 was inspected to ensure that it was of the proper configuration, undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-348.

The unit was then shipped to McDonnell Aircraft Corporation for installation of a propellant valve support bracket and a new aft mounting tab per MAC Drawing 52-52701-275J.O.S.306-6-93. This modification was necessitated as the result of earlier vibration failures which occurred during tests conducted by both Rocketdyne and MAC. A potting compound was also added by MAC to the cavity between the thrust chamber body and the CRES shell. Following the return of the unit to Rocketdyne, simulated spacecraft system tube extensions (P/N 99-106688 and 99-106689) were attached to the TCA inlet tube stubs per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

Visual inspection was successfully completed.

VIBRATION TEST

Description

Unit 1 was subjected to a random vibration test along each of the three mutually perpendicular axes. The test sequence for each axis was as follows:

1. A 1-g sine wave survey
2. An equalization test to verify spectrum shape and tolerance
3. A random vibration test with a duration of 8 minutes minus the equalization time

The order in which the axes were tested was X, Y, and Z.

Propellant valve proof pressure tests were conducted following the X-axis and Y-axis vibration tests. Complete proof pressure, leakage, and functional tests were conducted following the Z-axis vibration.

Results

Unit 1 successfully completed the vibration test. The spectrum, however, was out of tolerance in the 625- to 710-cps range in the Y-axis per Fig. 8, Appendix D, page 375. The power spectral density peaked out with 0.053 g^2/cps at 690 cps. This was not considered detrimental, and testing was continued per Rocketdyne Internal Letter 4388-5404 (page 192 of Appendix D). The TCA successfully completed all the proof pressure, leakage, and functional tests.

MECHANICAL SHOCK TEST

Description

Unit 1 was placed in the standard shipping container and was subjected to three shocks in each direction along each of the three major axes. The shocks were of 15 g magnitude and 11 milliseconds duration. Proof pressure, internal leakage, and functional tests were conducted after completion of the shock test.

Results

The mechanical shock test was successfully completed and the TCA passed all of the post-shock, proof pressure, leakage, and functional tests.

TEMPERATURE SHOCK

Description

Unit 1 was placed in a 185 F temperature chamber and exposed to this environment for a period of 4 hours. It was then transferred, within 5 minutes, to a second temperature chamber where it was exposed to a temperature of -40 F for 4 hours.

This sequence was repeated until a total of three heating and three cooling cycles was accumulated. The TCA was then allowed to return to room temperature. Within 1 hour after the TCA returned to room temperature, proof pressure, internal leakage and functional tests were conducted.

Results

The temperature shock test was successfully completed and the TCA passed the posttest proof pressure, leakage, and functional tests.

MISSION DUTY CYCLE TO FAILURE

Description

Unit 1 was installed in the hot-fire test facility and was subjected to a mission duty cycle (MDC) to failure. The first portion of the MDC was a "cape firing cycle" conducted at local ambient pressure and temperature, after which the TCA was allowed to return to ambient temperature. The second portion of the MDC consisted of pulses 1 through 9 of MDC OCM-217. This portion of the MDC was conducted at a simulated pressure altitude in

excess of 100,000 feet. The third portion of the MDC consisted of pulse No. 10 (a steady-state continuation of MDC Pulse No. 9) until failure. This firing was also conducted at a simulated altitude in excess of 100,000 feet. (See Table II, page 366, of Appendix D.)

Results

The DAT mission duty cycle to failure was successfully completed. Failure occurred after 366 seconds of accumulated burn time. The mode of failure was excessive skin temperature at the throat. This failure was preceded by ejection of the throat insert. Ejection of the throat insert was not defined as a failure during this test.

DISASSEMBLY AND INSPECTION

Description

Unit 1 was visually inspected for any defects, damage, or abnormal wear. A record was made of pertinent items of condition visible prior to disassembly. The disassembly consisted of (1) removal of the MAC propellant valve support bracket, (2) removal of the propellant valves, (3) sectioning of the propellant valves at the fabrication welds, (4) disassembly of the propellant valve internal parts, and (5) sectioning of the thrust chamber body. The propellant valve parts and thrust chamber sections were visually inspected to determine internal condition. A record was made of the pertinent items.

Results

The predisassembly inspection revealed that (1) the throat insert had been ejected, (2) the first and second JTA liner segments adjacent to the throat were missing and the third JTA segment was eroded, (3) the combustion zone sleeve was severely eroded in the area adjacent to the throat, and (4) there were delaminations and blisters in the nozzle ablative material. During the sectioning of the seat assembly weld of the oxidizer valve, the cutting tool caught and tore the seat assembly from the valve body. As a result of this, the oxidizer valve armature and spring could not be removed without further machining which would have damaged the detail parts.

The postdisassembly inspection revealed, in addition to verification of the predisassembly items, that (1) the ablative material was charred to the OD along most of the length of the TCA, (2) the asbestos wrap was charred and delaminated, (3) the glass wrap was charred, (4) there were delaminations in the combustion zone ablative material, and (5) the McDonnell Aircraft Corporation installed potting material was badly deteriorated.

TEST DESCRIPTION AND RESULTS, UNIT 2

VISUAL INSPECTION

Description

Unit 2 was inspected to ensure that it was of the proper configuration, undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-348.

MISSION DUTY CYCLE TO 147 SECONDS IN SPECIFICATION
LIFE AND BURST PRESSURE TEST

Description

Prior to the mission duty cycle (MDC) test, Unit 2 was reworked by removing the propellant metering orifices. Unit 2 was installed in the hot-fire test facility and the propellant metering orifices were installed in special orifice adapters (P/N 99-106726 and 99-106727). These special adapters were installed in the test facility propellant system so that the propellant would be allowed to flow through the orifices during the MDC test and later bypass the orifices during the high-chamber-pressure burst test. A hot-gas recirculation shield was installed around the TCA to prevent convective heating of the TCA skin.

The first portion of the MDC was a "cape firing cycle" conducted at local ambient pressure and temperature conditions. After this firing cycle, the TCA was allowed to return to local ambient temperature.

The second portion of the mission duty cycle consisted of the first part of MDC OCM-217 required to meet 147 seconds of MDC burn time. Following the MDC, the TCA shell temperature was allowed to reach the maximum value resulting from thermal soakout. The MDC and the soakout were conducted at a simulated pressure altitude in excess of 100,000 feet.

During the soakout following the MDC, the propellant tank pressures were raised to 750 psig and the orifice adapter bypass valves were opened. At the completion of soakout, a 3-second steady-state burst pressure firing was conducted. The burst pressure test also was conducted at a simulated pressure altitude in excess of 100,000 feet.

Results

The MDC to 147 seconds was successfully completed. During the soakout period following the MDC, however, the TCA throat station skin temperature exceeded the allowable limit of 700 F. The temperature reached a maximum of 754 F. This failure is reported in OFR/FAR No. 12923R, Appendix B. Testing was continued with the hot-fire burst pressure test. It was believed that more information would be obtained by conducting the hot-fire burst pressure test with the high skin temperature than terminating the test at this point for failure analysis.

The hot-fire burst pressure test was successfully completed without any evidence of TCA deterioration. A chamber pressure of 368 psia was obtained during this test.

DISASSEMBLY AND INSPECTION

Description

Unit 2 was visually inspected for any defects, damage, or abnormal wear. A record was made of the pertinent items visible prior to disassembly. Disassembly consisted of (1) removal of the propellant valves, (2) sectioning of the propellant valve fabrication welds, (3) disassembly of the propellant valve internal parts, and (4) sectioning of the thrust chamber body. The propellant valve parts and thrust chamber sections were visually inspected to determine internal condition. A record was made of the pertinent items.

Results

The predisassembly inspection of Unit 2 revealed that (1) there were delaminations and blisters in the nozzle ablative material, and (2) there was a 360-degree delamination in the nozzle ablative material approximately 1 inch downstream of the throat. The postdisassembly inspection revealed that (1) there were delaminations in the combustion zone ablative material, (2) there were delaminations in the nozzle ablative material, and (3) the char front extended into the asbestos wrap at the throat station.

TEST DESCRIPTION AND RESULTS, UNIT 3

VISUAL INSPECTION

Description

Unit 3 was inspected to ensure that it was of the proper configuration, undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-348.

The unit was then modified by the addition of special tube stub connectors (P/N 99-106126) to the existing fuel and oxidizer propellant valve inlet tube stubs. Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

The visual inspection was successfully completed.

THRUST VECTOR TEST

Description

Unit 3 was installed in the hot-fire test facility and subjected to a thrust vector determination test. The test consisted of two 0.25-second pulses for thermal equalization of the propellant feed system, and two 2.75-second steady-state tests for thrust vector determination. The off time between firings was 3 seconds.

Results

The thrust vector test was successfully completed.

MISSION DUTY CYCLE TO 270 SECONDS (GUARANTEED LIFE)

Description

Unit 3 was installed in the hot-fire test facility and subjected to mission duty cycle (MDC) OCM-217 to 270 seconds (guaranteed life). Following the MDC, the TCA temperature was allowed to soak out. The MDC and the soakout were conducted at a simulated pressure altitude in excess of 100,000 feet.

Results

The MDC to 270 seconds was successfully completed.

PROPELLANT VALVE SERVICE LIFE TEST

Description

Unit 3 was installed in a service life test facility. The valves were then to have been cycled as follows: (1) 5000 cycles with GN_2 at 200 psig inlet pressure and a room temperature environment, (2) 5000 cycles with 200 F water at 200 psig inlet pressure while in a 250 F environment, (3) 20,000 cycles with 160 F water at 200 psig inlet pressure while in a 160 F environment, and (4) 20,000 cycles with a 15 F water-ethyl alcohol mixture at 150 psig inlet pressure while in a 15 F environment. Each group of 5000 cycles consisted of 1000 cycles each at rates of 1, 2, 3, 4, and 5 cps. In all tests, the valves were energized simultaneously and the valve voltage was 26 vdc.

Valve functional tests were conducted before and after the service life tests, and proof pressure, internal leakage and functional tests were conducted following the room temperature, 200, and 160 F tests.

Results

The room temperature cycling was completed successfully. The 200 F water/250 F environment test was completed successfully; however, four deviations were necessary. These were authorized by two Rocketdyne Internal Letters. Letter 4388-5411 (page 315 of Appendix D) authorized water temperature variations from 195 F to 210 F (specification requirement 200 ±5 F) and also authorized oxidizer valve opening time to be 0.0215 second (requirement 0.021 second). This was required because the high environmental temperature increased the valve coil resistance, thus increasing the valve opening time. The second letter, 4388-5410 (page 314 of Appendix D),

authorized changes to the order of conducting the valve leak and functional tests to expedite testing. The 160 F water/160 F environment cycling was completed successfully. The 15 F water-alcohol/15 F environmental cycling was completed successfully; however, deviations were again necessary. These were also authorized by Rocketdyne Internal Letters. The first letter, 4388-5412 (page 316 of Appendix D), authorized the use of isopropyl alcohol in place of ethyl alcohol to reduce the fire hazard; this letter also called for the use of filters in the facility system when recirculating the water-alcohol mixture because of the presence of char particles from the fired TCA. Two other letters, 4388-5413 and 4388-5414 (page 317 and 318 of Appendix D), authorized the application of a sealing compound to both the throat insert and nozzle to prevent leakage of the water-isopropyl alcohol mixture through the ablative of the fired TCA. A fourth letter, 4388-5416 (page 320 of Appendix D), authorized changes to the sequence of conducting the valve tests to expedite testing. During the postservice-life electrical resistance test it was found that current leakage existed between pin A and ground of the fuel valve of 4000 microamps with an applied voltage of 200 v rms; the allowable current leakage is 500 microamps at 500 v rms applied voltage. This failure is reported in OFR/FAR 12981R (page 51 of Appendix B). A final deviation was necessary to allow testing of the oxidizer valve before completion of analysis of the fuel valve failure, as this did not affect the validity of the oxidizer valve tests; this was authorized by Rocketdyne Internal Letter 4388-5190 (page 321 of Appendix D).

DISASSEMBLY AND INSPECTION

The fuel valve was removed from Unit 3 and sectioned as a part of failure analysis. A description of the condition of the TCA is contained in OFR/FAR 12981R.

Description

Unit 3 was visually inspected for any defects, damage, or abnormal wear. A record was made of pertinent items of condition prior to disassembly. The disassembly consisted of (1) removal of the oxidizer valve, (2) sectioning of the oxidizer valve at the fabrication welds, (3) disassembly of the oxidizer valve internal parts, and (4) sectioning of the thrust chamber body. The oxidizer valve parts and the thrust chamber sections were visually inspected to determine internal condition. A record was made of the pertinent items.

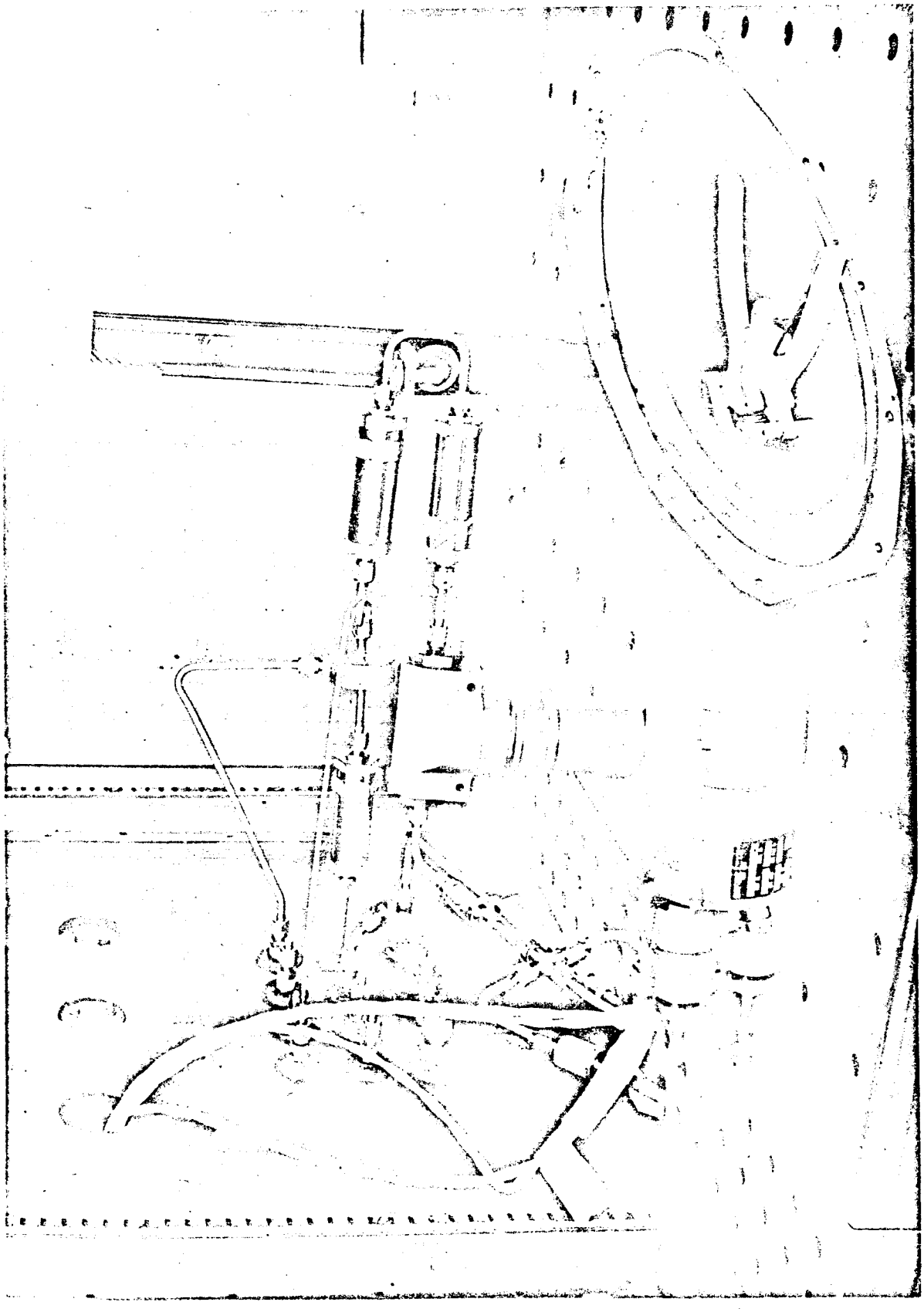
Results

The predisassembly inspection revealed slight throat cracking; however, the sealing compound applied to the nozzle during propellant valve service life test prevented determination of the nozzle condition during the predisassembly inspection.

The postdisassembly inspection revealed (1) charring of the ablative material to the OD along approximately 80 percent of the thrust chamber length, (2) slight charring of the asbestos, (3) severe delamination of the 90-degree ablative material immediately upstream of the throat, (4) moderate delamination of the nozzle ablative material, (5) the throat insert and JTA liners were broken during sectioning, and (6) slight scratching of the oxidizer valve armature.

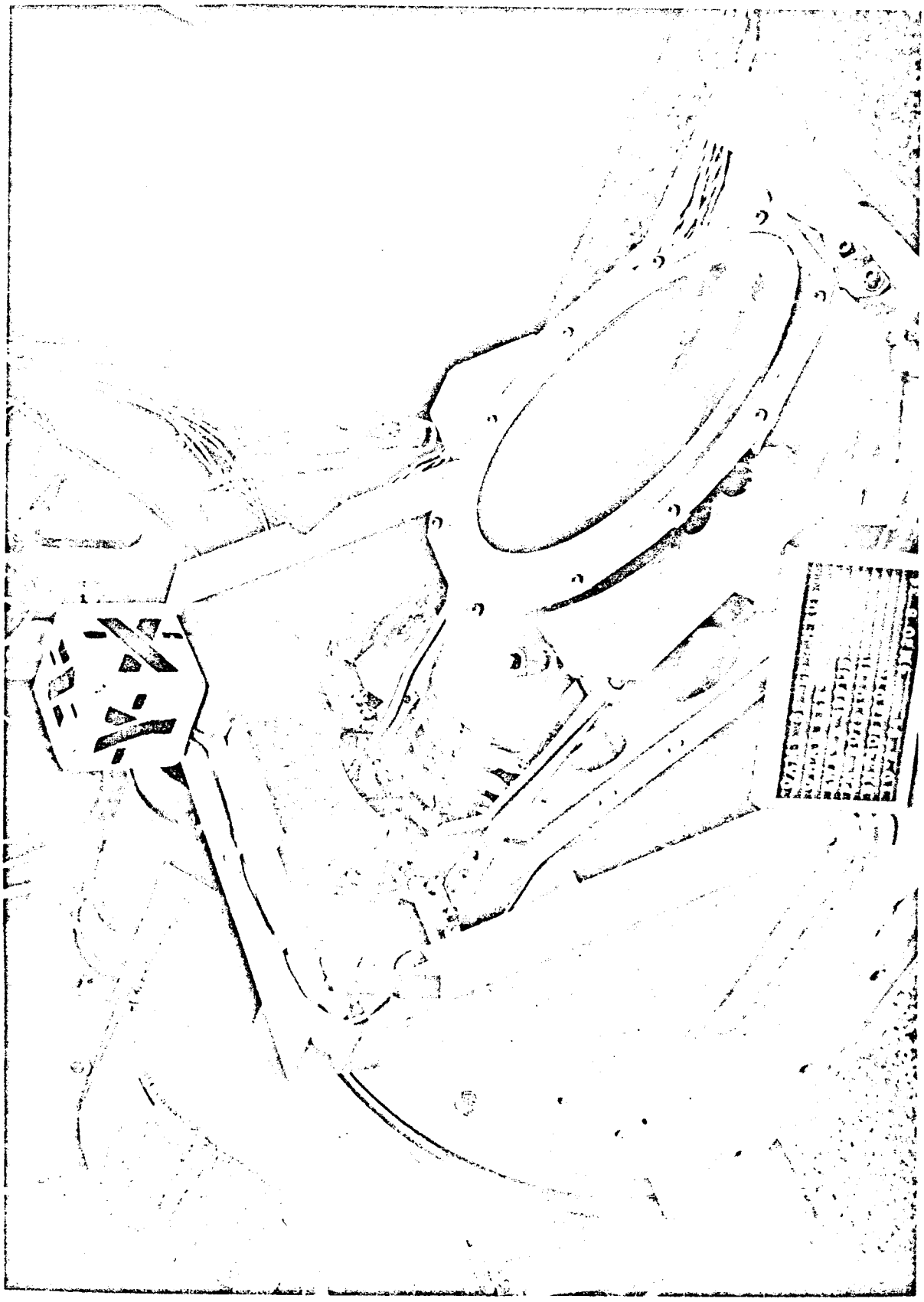
APPENDIX A

PHOTOGRAPHS OF TESTS AND TEST EQUIPMENT



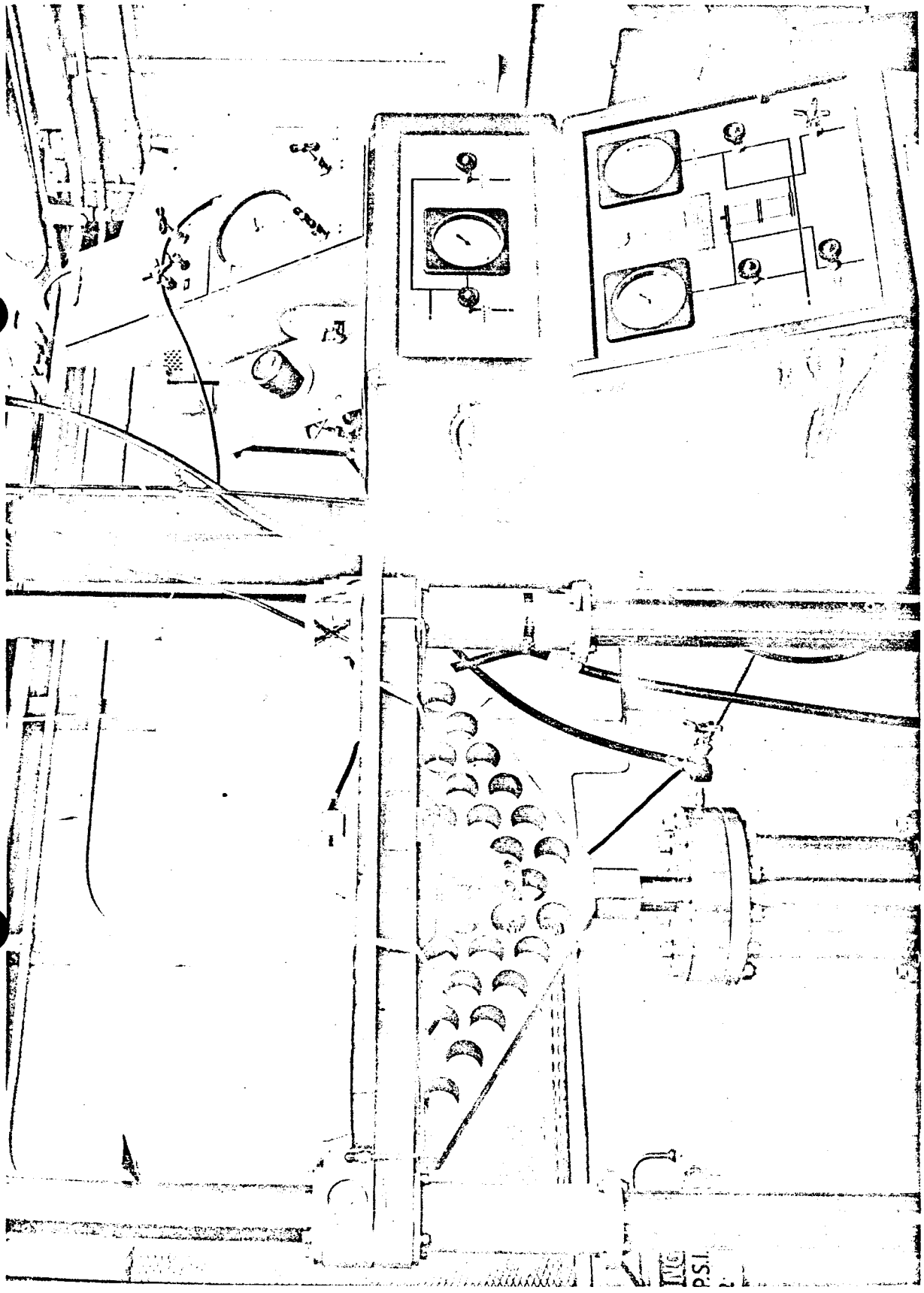
1HE34-10/24/64-C1B

Figure 4. 85-Pound-Thrust OAMS TCA Proof Pressure and Leak Test Setup



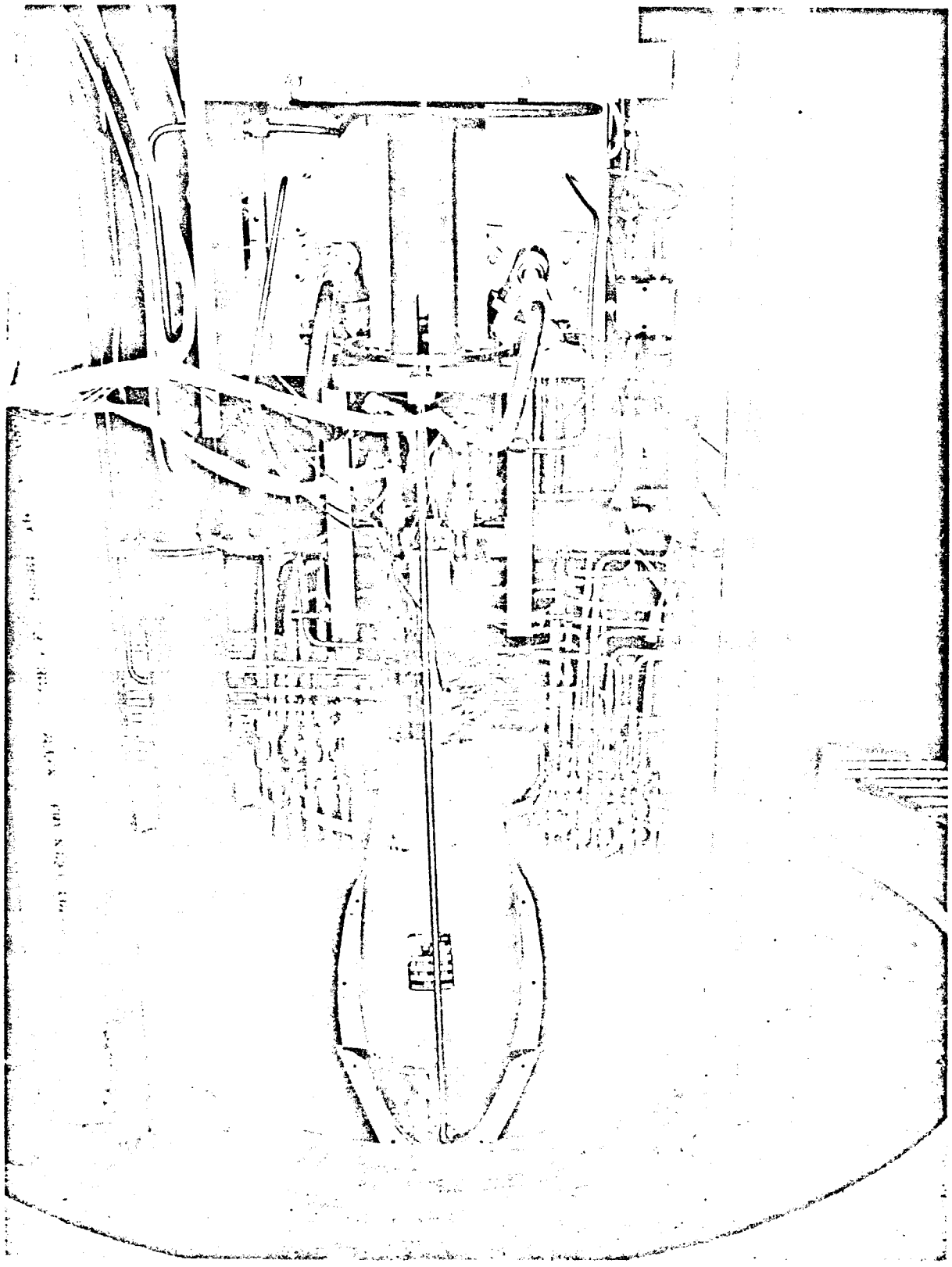
1HD33-10/2/64-C1C

Figure 5. 85-Pound-Thrust OAMS TCA DAT Unit No. 1 Y-Axis Random Vibration Test Installation



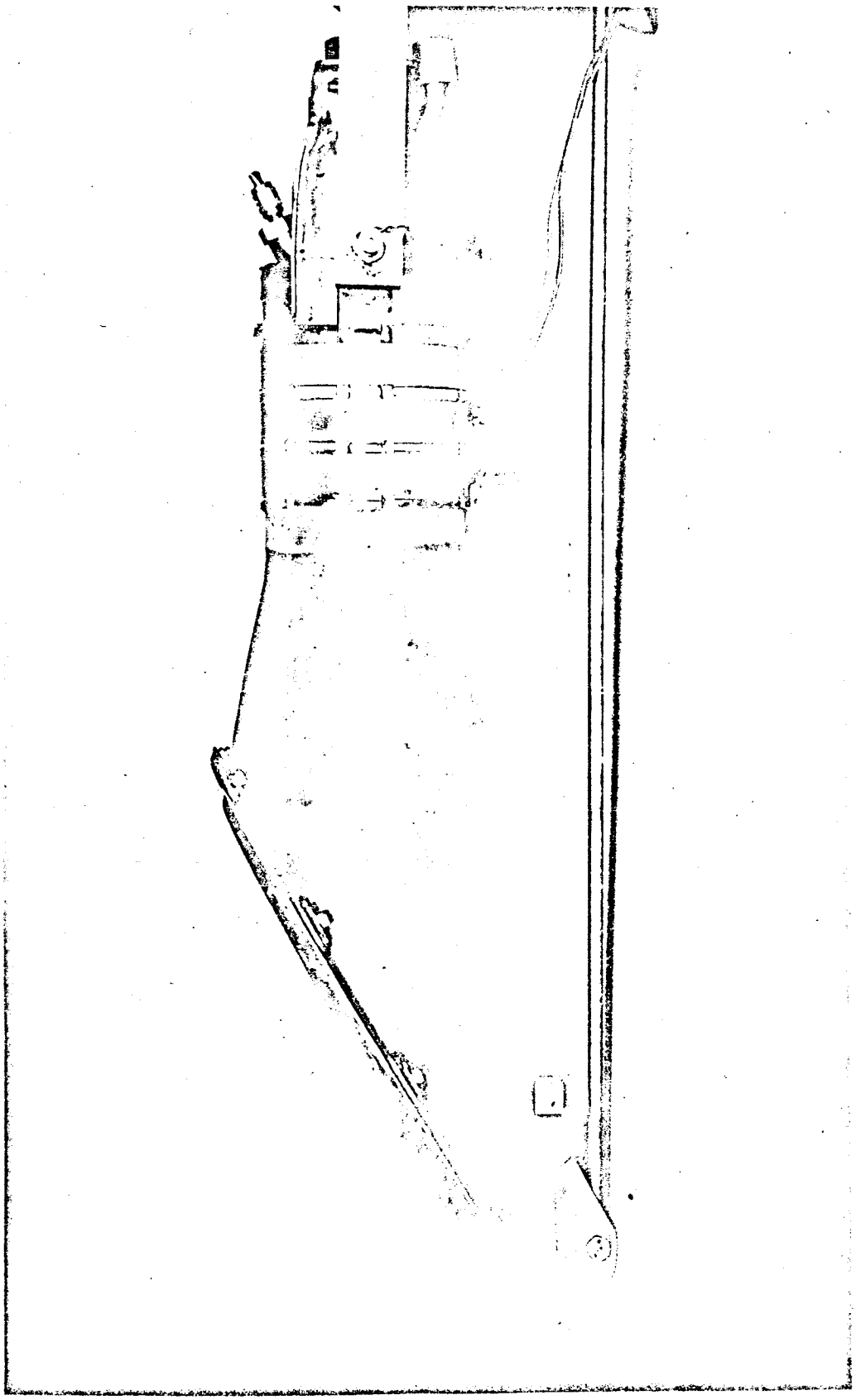
1HD34-10/13/64-C1A

Figure 6. 85-Pound-Thrust OAMS TCA Unit No. 1, Mechanical Shock Test Installation



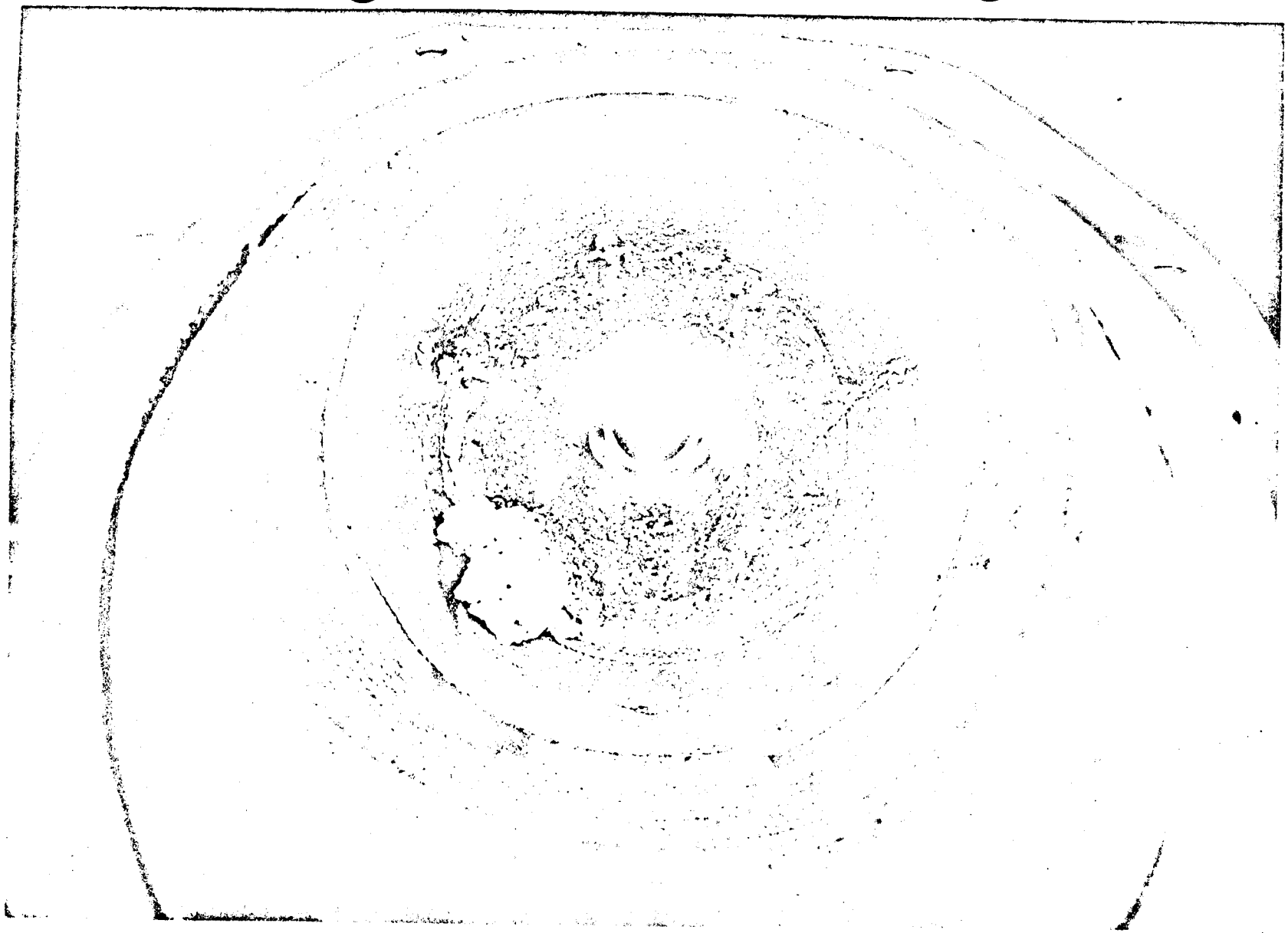
1HE33-10/23/64

Figure 7. 85-Pound-Thrust OAMS TCA DAT Unit No. 1, Hot-Fire Test Setup, MDC Cell 39K, CTL-3, SSFL



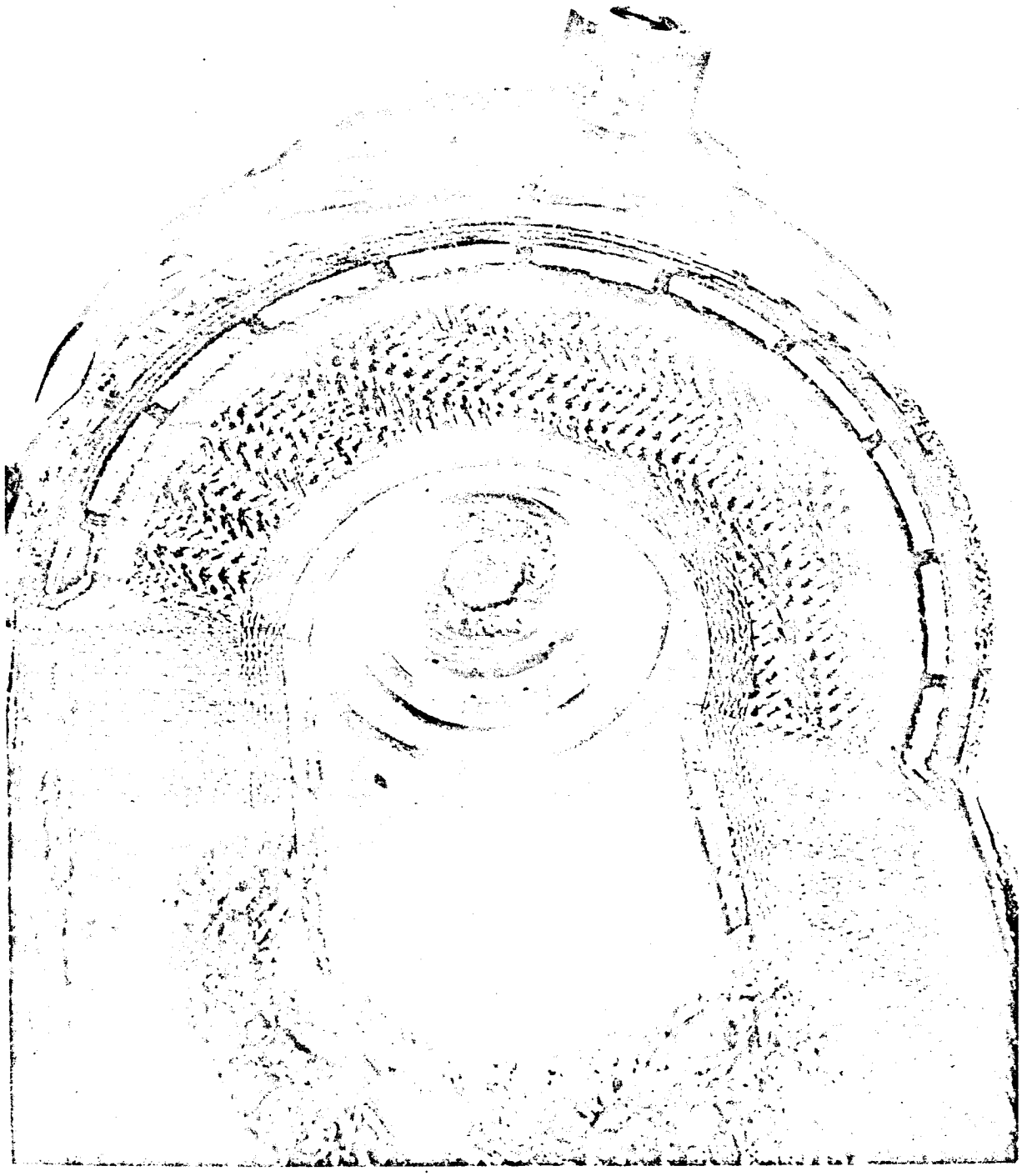
1HE25-10/24/64

Figure 8. 85-Pound-Thrust OAMS TCA DAT Unit No. 1, Post-MDC to Failure



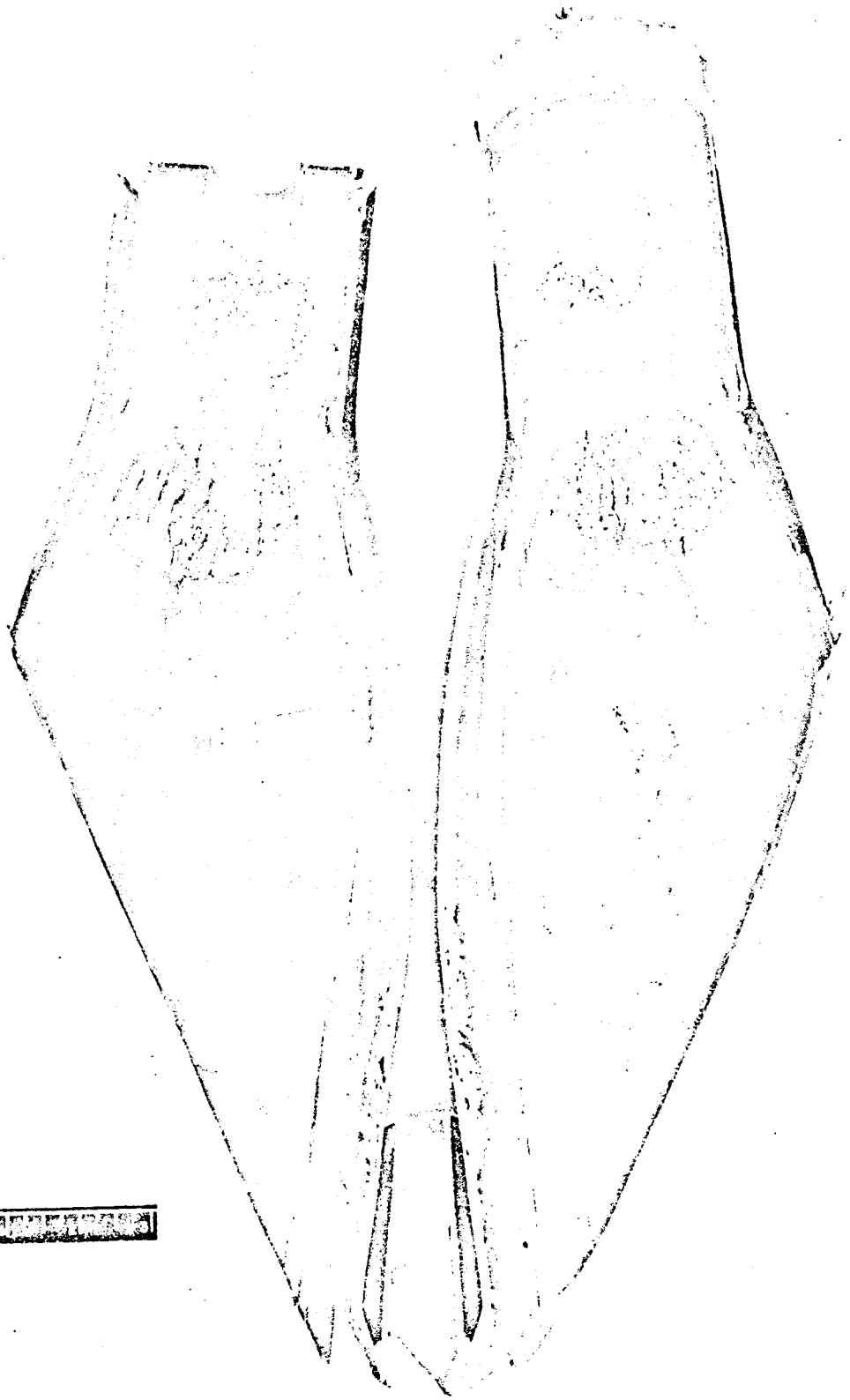
1HE25-10/24/64-S1D*

Figure 9. 85-Pound-Thrust OAMS TCA DAT Unit No. 1, Post-MDC to Failure, View of Thrust Chamber Throat



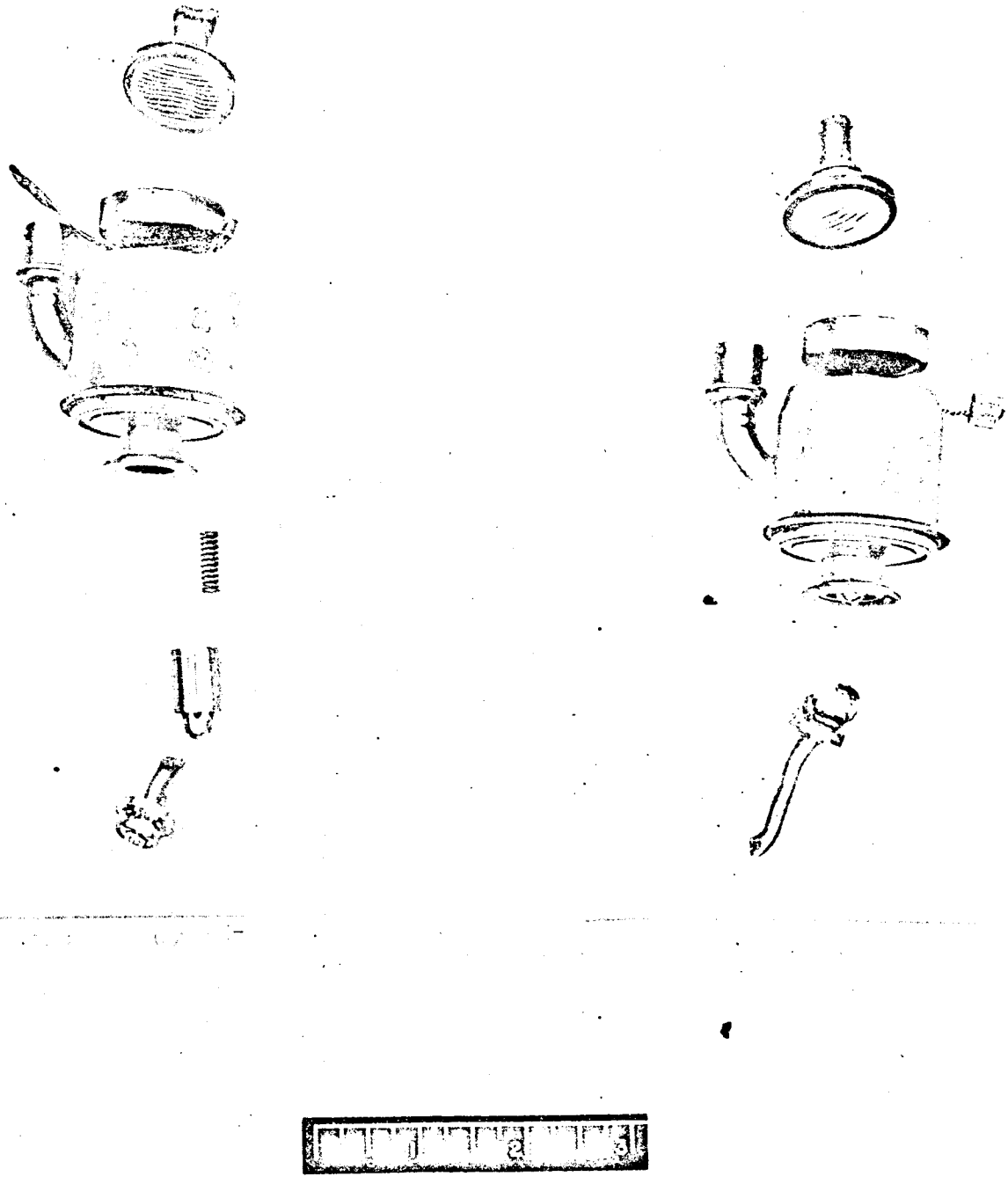
1HE35-6/14/65-C2B

Figure 10. 85-Pound-Thrust OAMS TCA DAT Unit No. 1, Post-MDC to Failure, Disassembly and Inspection



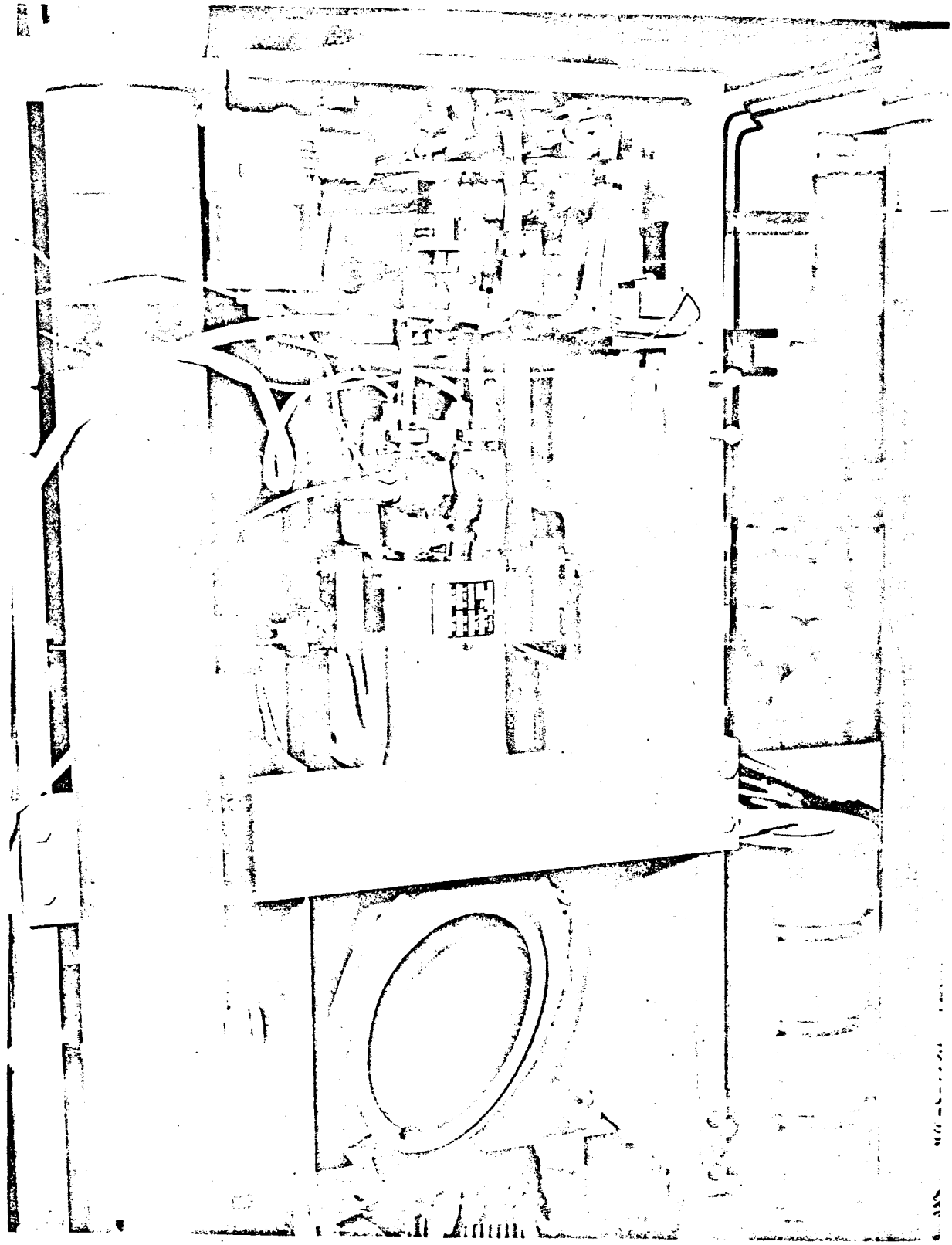
1HE35-6/14/65

Figure 11. Chamber Section of 85-Pound-Thrust OAMS TCA DAT Unit No. 1, Post-MDC to Failure, Disassembly and Inspection



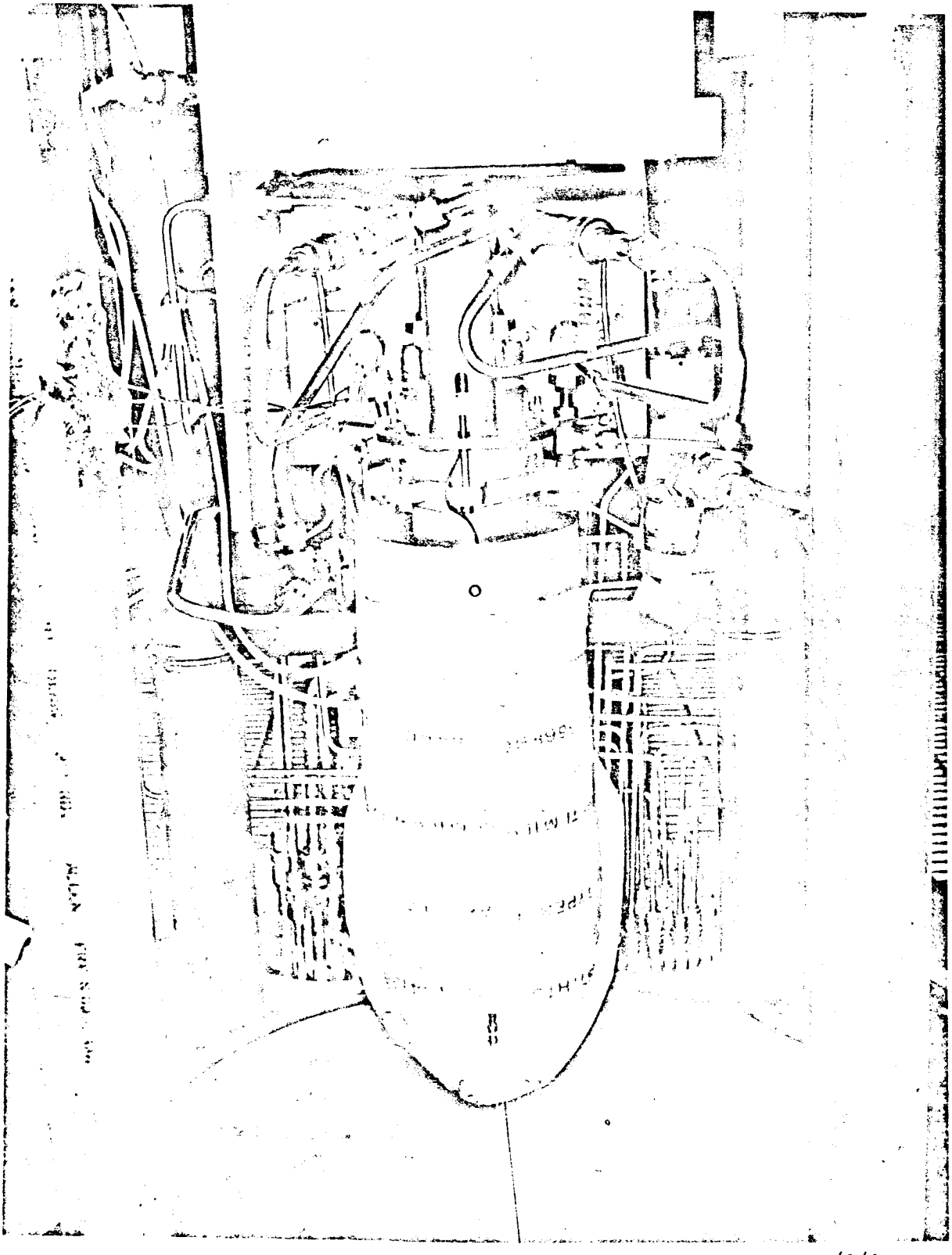
1HE65-6/8/65-C1

Figure 12. Propellant Valves From 85-Pound-Thrust OAMS TCA DAT Unit No. 1, Disassembly and Inspection



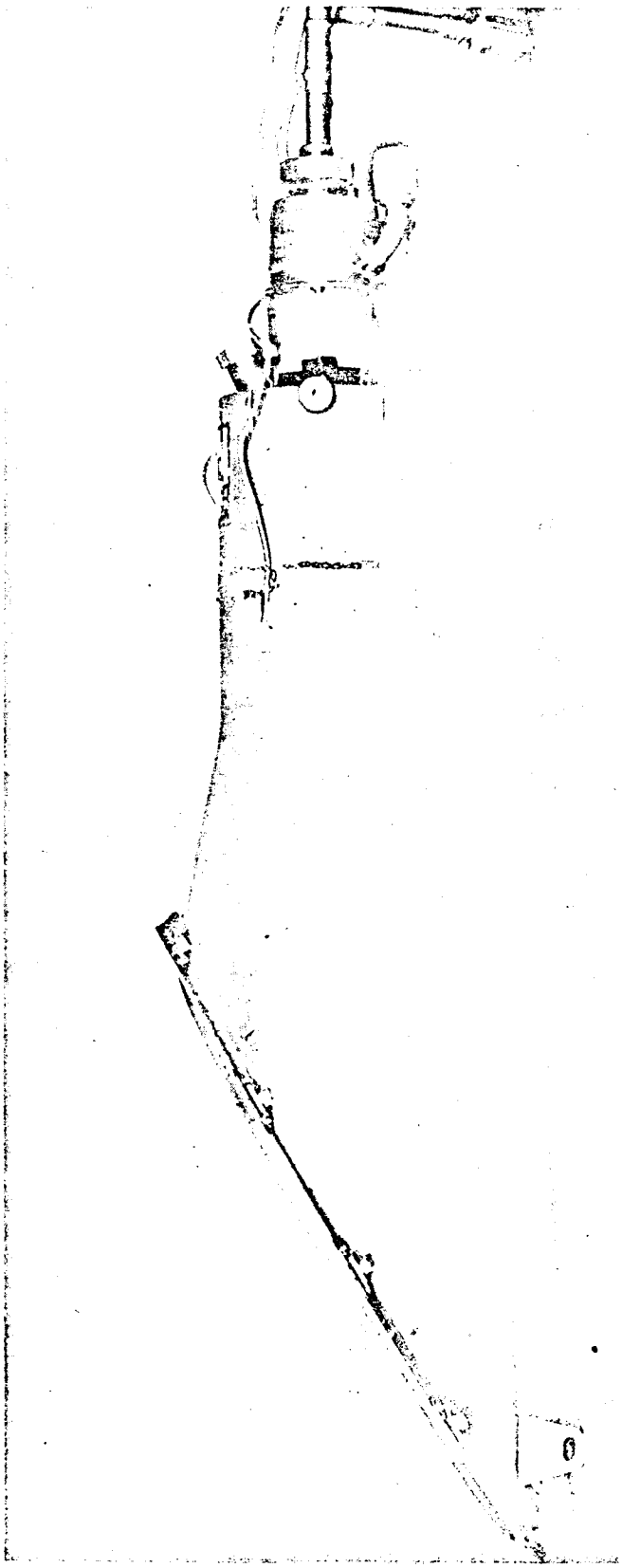
1HD23-10/10/64-S1A

Figure 13. 85-Pound-Thrust OAMS TCA DAT Unit No. 2, Hot-Fire Test Setup, Thrust Vector Test Cell 39L, CTL-3, SSFL



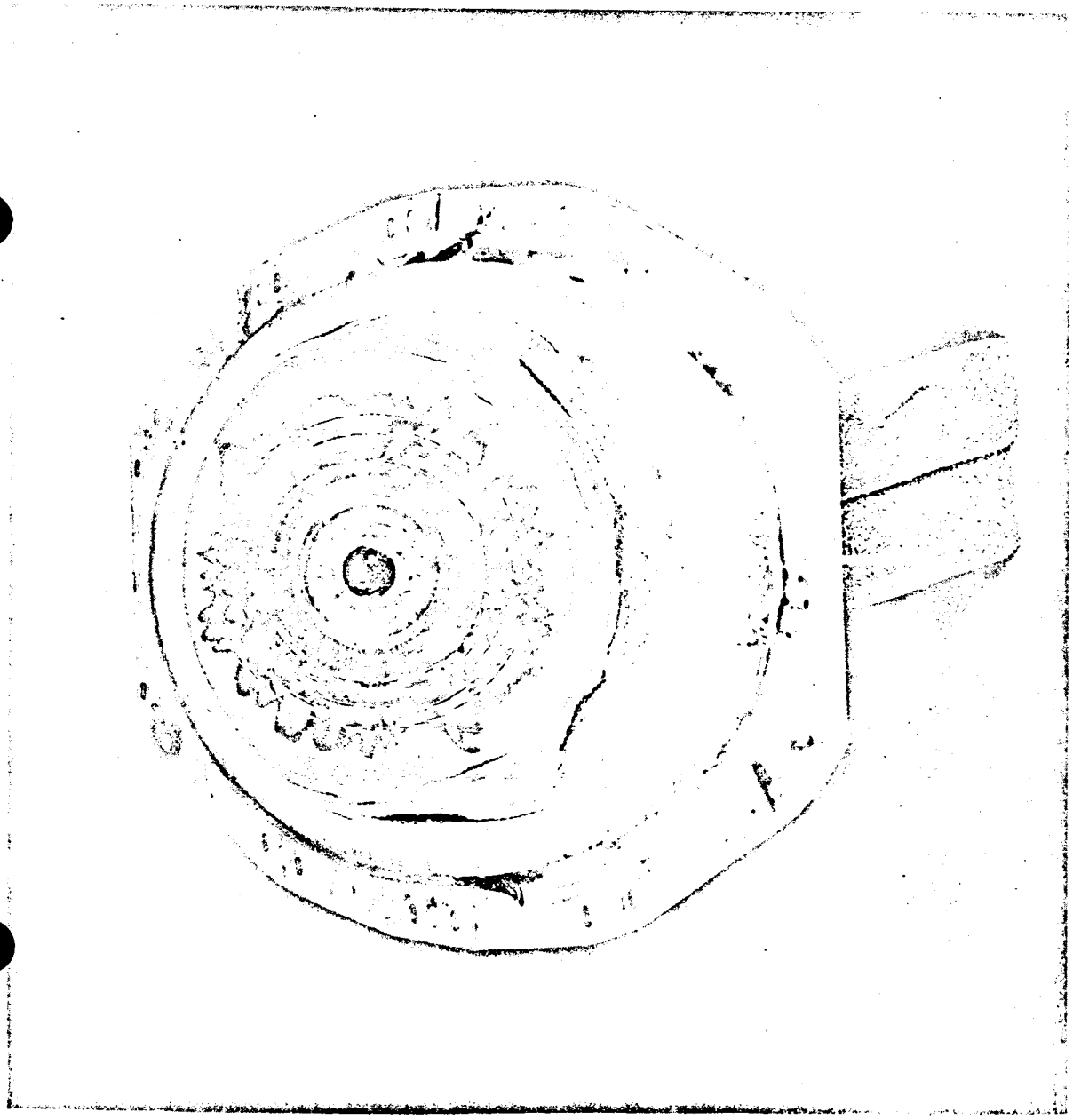
1HE33-11/6/64-S1A

Figure 14. 85-Pound-Thrust OAMS TCA DAT Unit No. 2, Hot-Fire Test Setup With Recirculation Shield, MDC and Burst Pressure Test Cell 39 K, CTL-3, SSFL



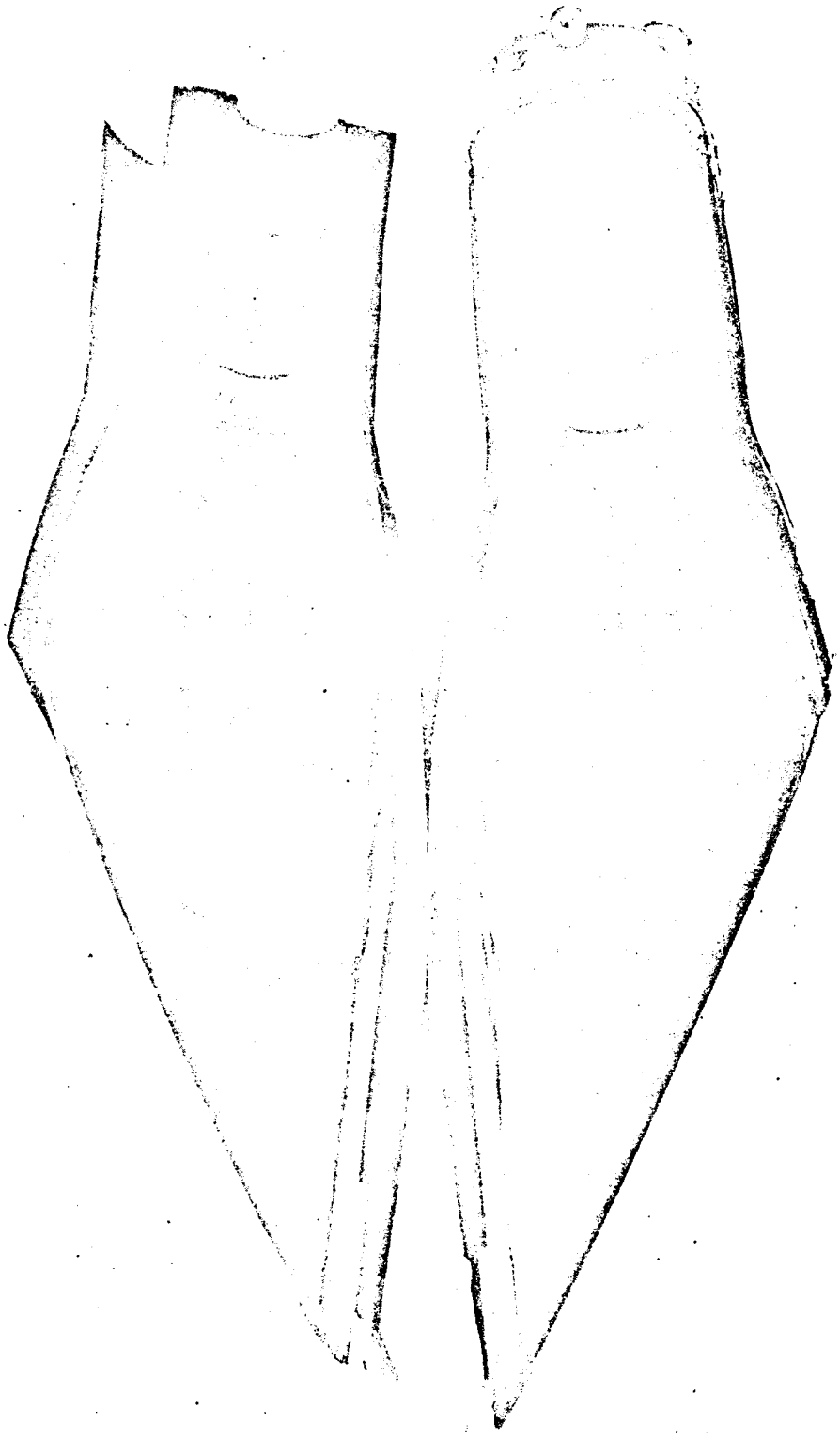
1HE32-11/9/64-S1B

Figure 15. 85-Pound-Thrust OAMS TCA DAT Unit No. 2, Post-MDC and Burst Pressure Test



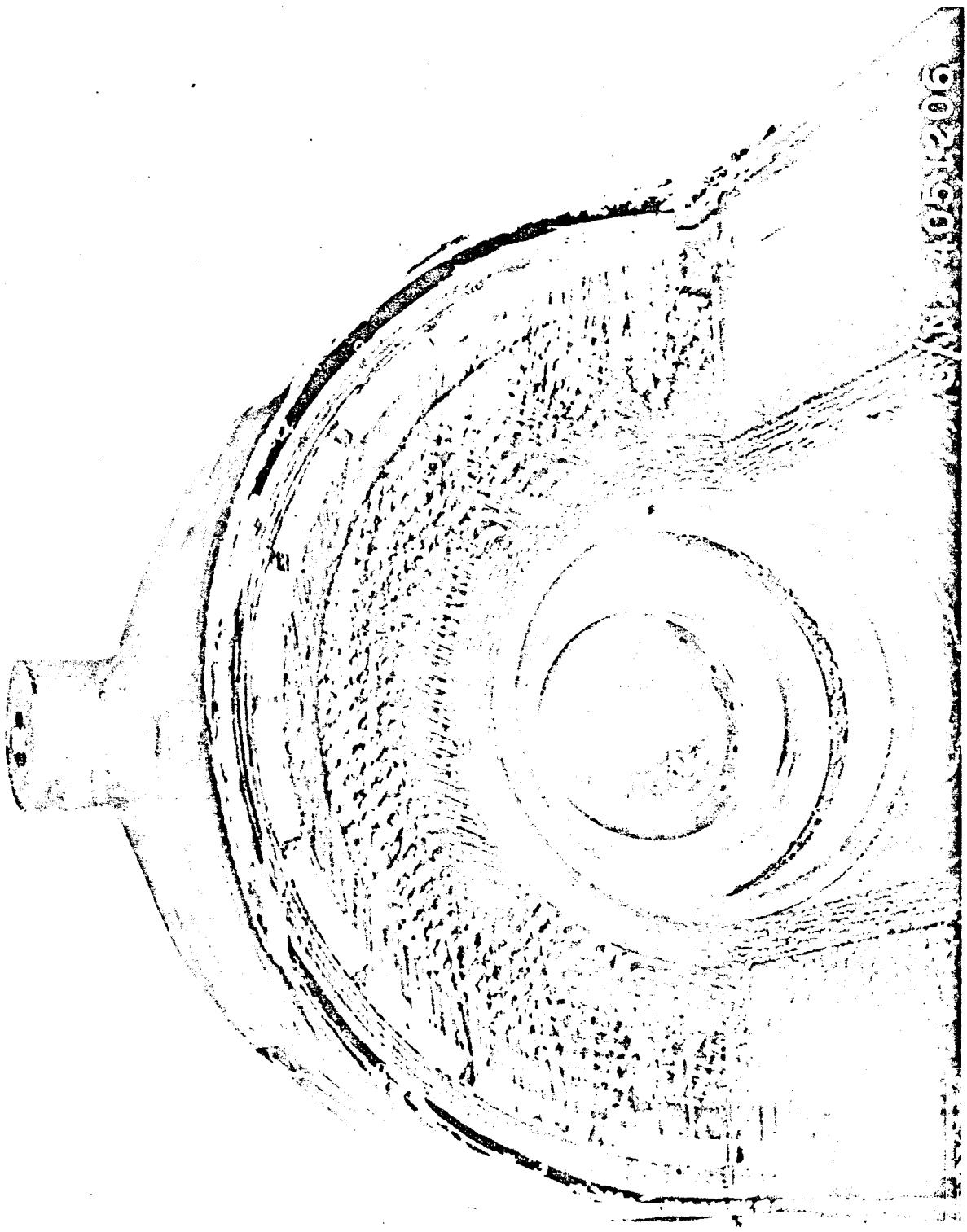
1HE32-11/9/64-S1A

Figure 16. 85-Pound-Thrust OAMS TCA DAT Unit No. 2, Post-MDC and Burst Pressure Test



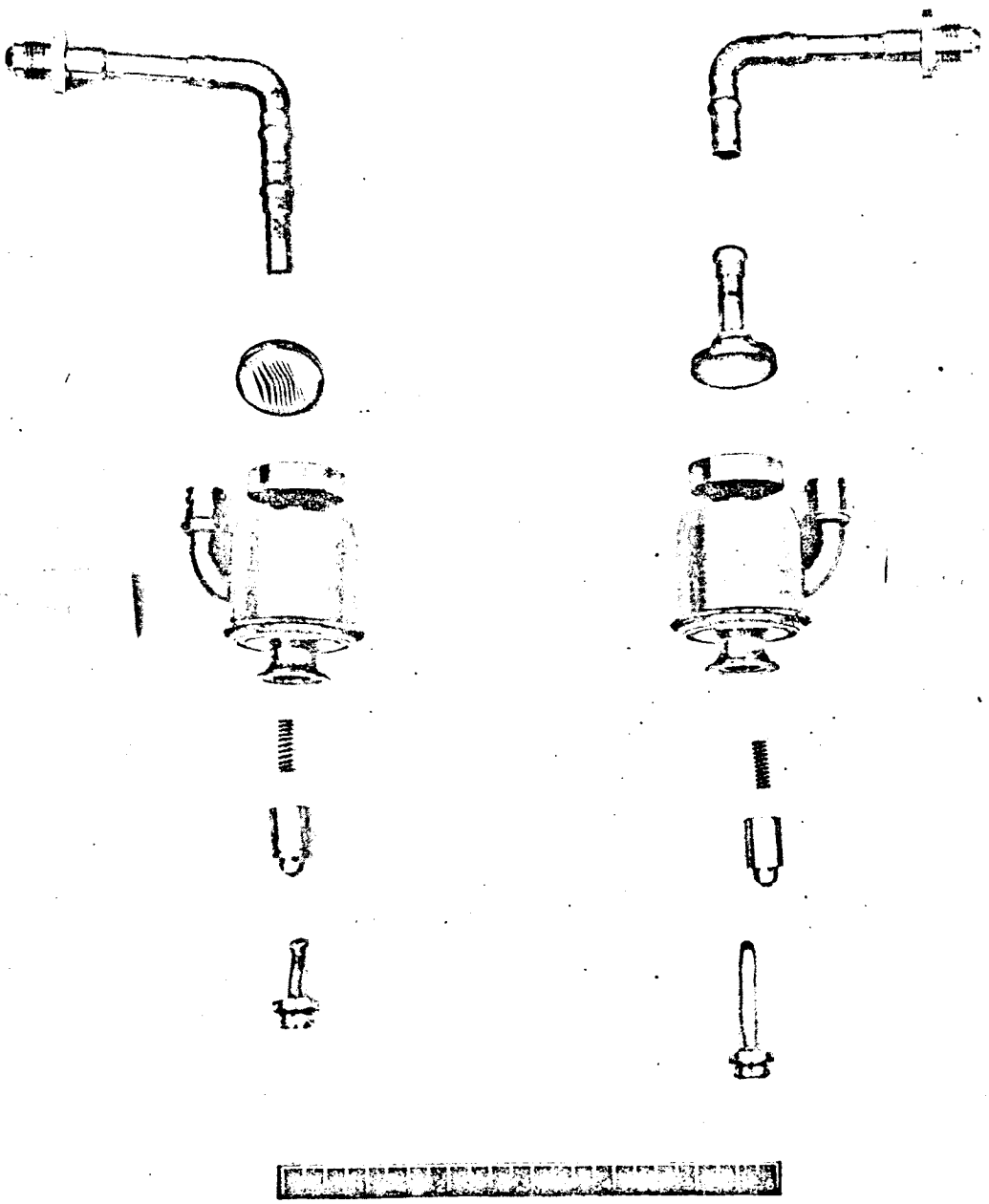
1HE35-5/17/65-C1B

Figure 17. Chamber Sections of 85-Pound-Thrust OAMS TCA DAT Unit No. 2, Disassembly and Inspection



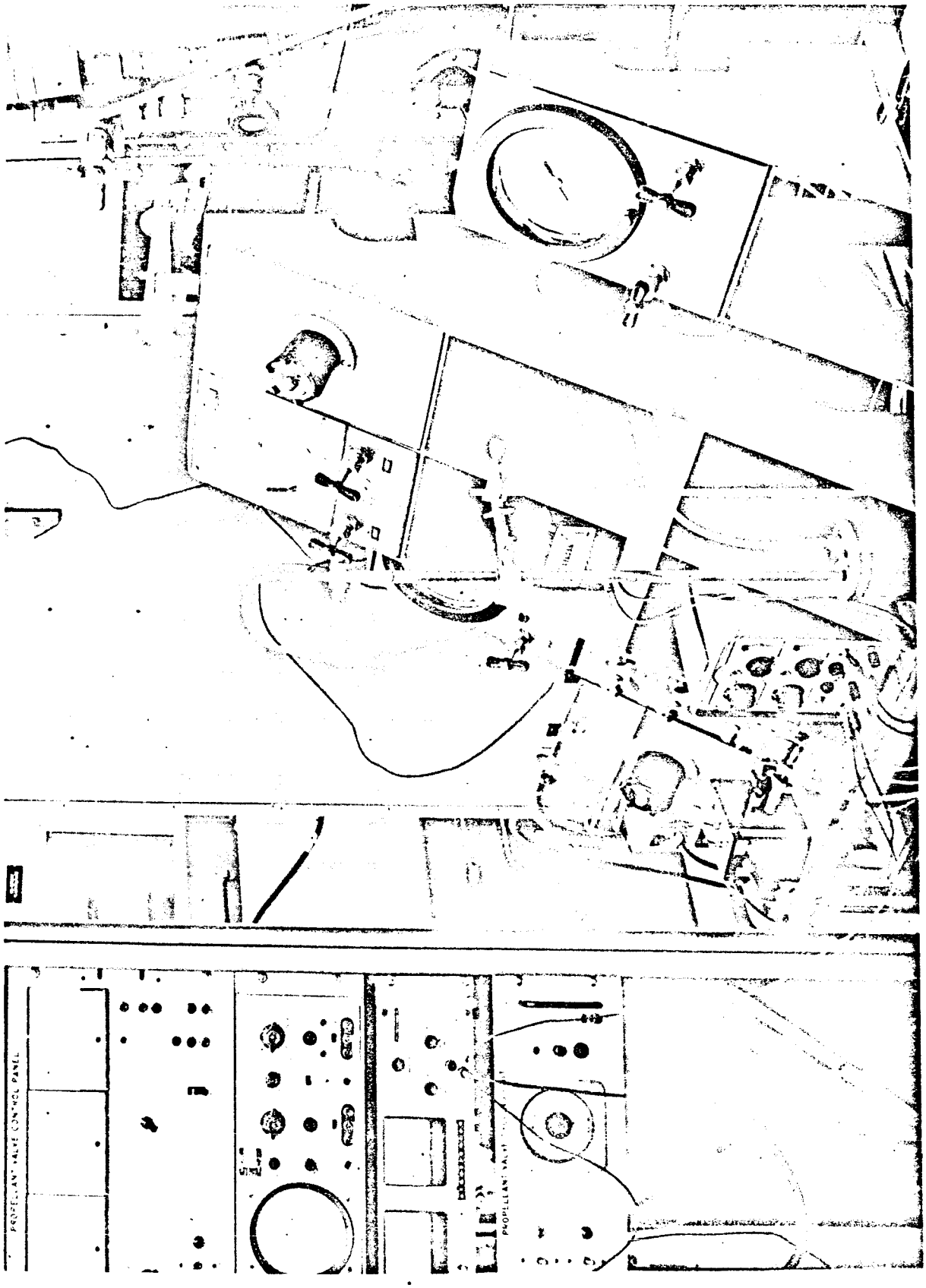
1HE35-5/17/65-C1A

Figure 18. 85-Pound-Thrust OAMS TCA DAT Unit No. 2, Disassembly and Inspection



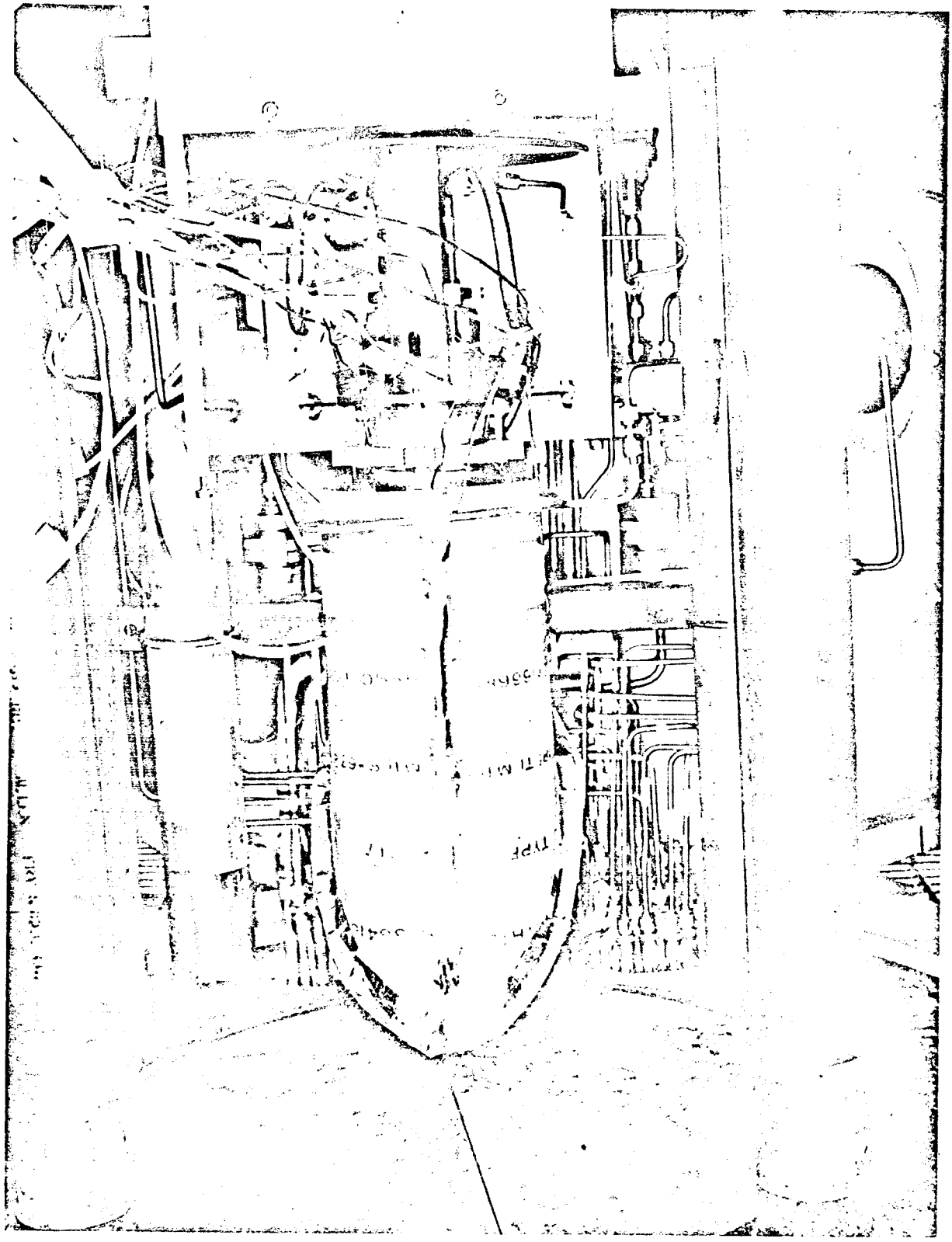
1HE65-5/13/65-C1

Figure 19. 85-Pound-Thrust OAMS TCA Unit No. 2, Disassembly and Inspection, Propellant Valves



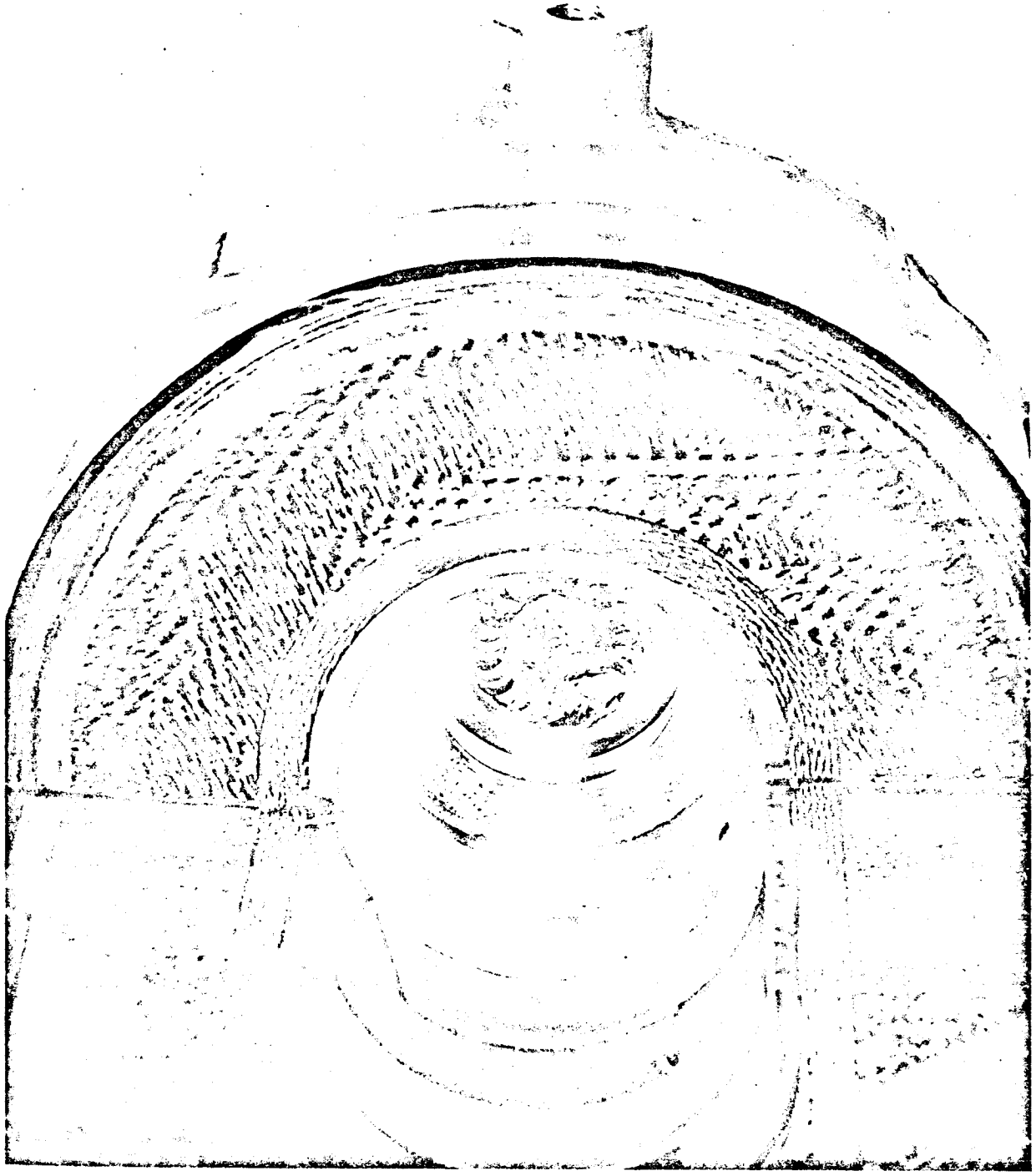
1HD63-11/10/64-C1A

Figure 20. 85-Pound-Thrust OAMS TCA DAT Propellant Valve Service Life Test Recording Instrumentation



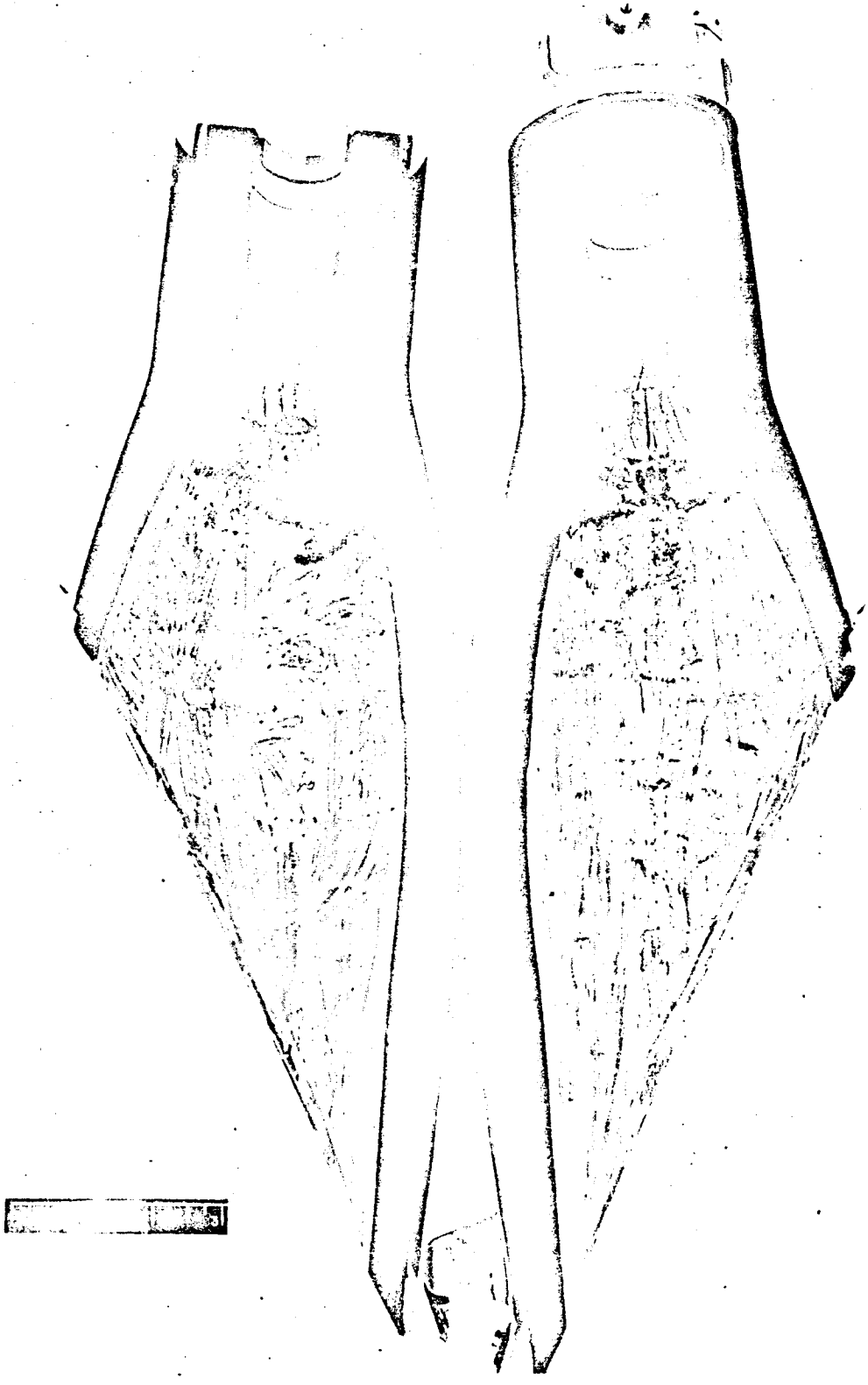
1HE23-10/16/64-S1A

Figure 21. 85-Pound-Thrust OAMS TCA DAT Unit No. 3, Hot-Fire Test Setup With Recirculation Shield, MDC Cell 39 K, CTL-3, SSFL



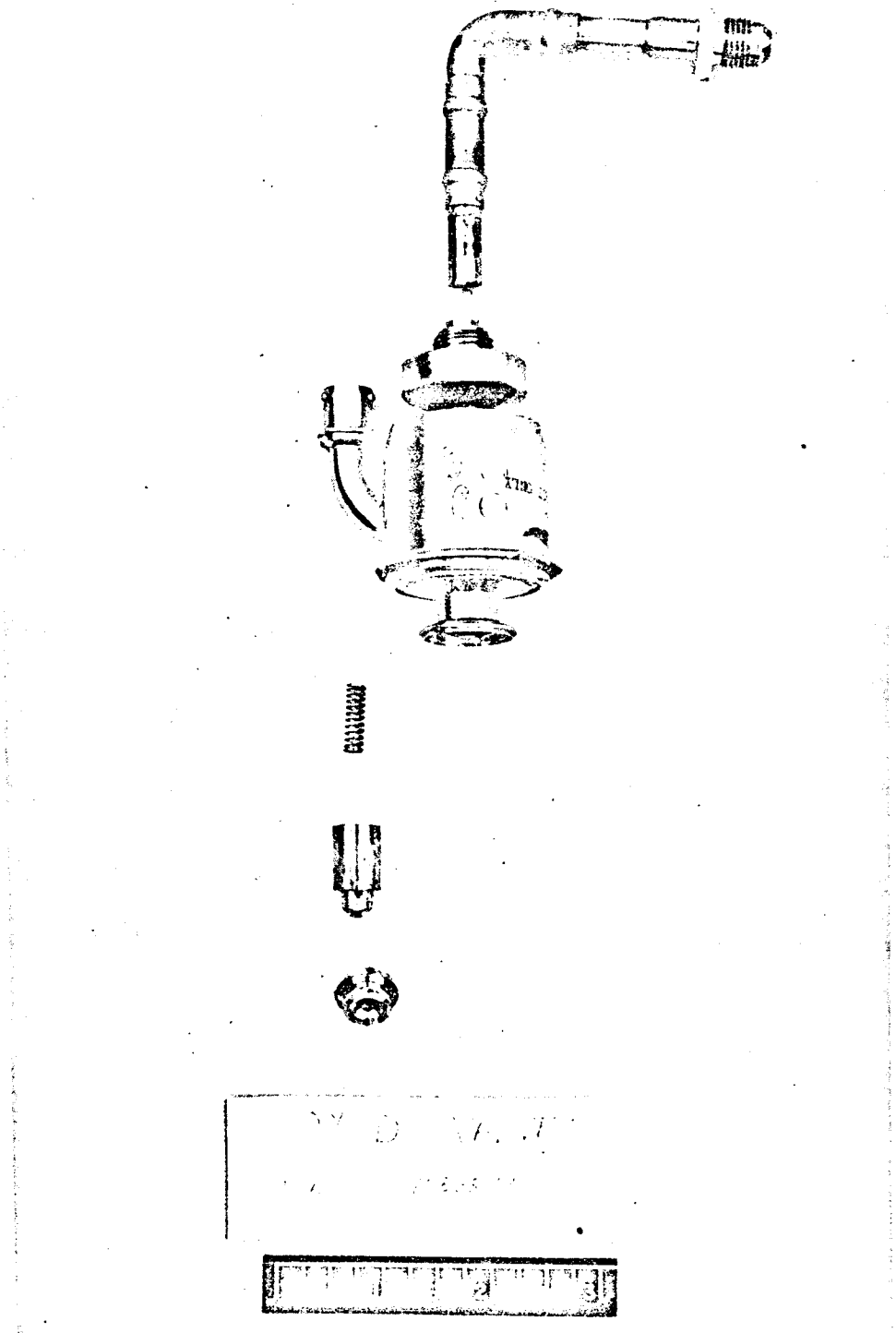
1HE35-6/14/65-C1B

Figure 22. 85-Pound-Thrust OAMS TCA DAT Unit No. 3, Disassembly and Inspection



1HE35-6/14/65

Figure 23. Chamber Sections Showing Sealant in Nozzle of 85-Pound-Thrust OAMS TCA DAT Unit No. 3, Disassembly and Inspection



1HE65-6/9/65-C1

Figure 24. Oxidizer Valve of 85-Pound-Thrust OAMS TCA DAT Unit No. 3, Disassembly and Inspection

APPENDIX B

APPENDIX B

OPERATION AND FAILURE REPORTS AND FAILURE ANALYSIS REPORTS

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Operation and Failure Report
ROCKETDYNE

PART CHANGE — [X] FAILED ITEM [ ] TIME EXPIRED [ ] TO DIRECTED | DATE | C.P. | № 12981R

PART IDENTIFICATION

1 PART NO.	2 PART NAME
207510-21	85# TCA

3 SERIAL NO.	4 MFG. NAME	5 MFR. CODE	6 REF DESIG.
4053579	ROCKETDYNE	02602	

7 NEXT ASSY PART NO.	8 NEXT ASSY SERIAL	9 NEXT ASSY NAME
NONE	NONE	NONE

10 MISSILE SERIAL NO.	11 ENG/AGE MODEL NO.	14 SYSTEM CODE
	SE7	15 COMPONENT CODE
12 REJ TAG NO.	13 ENG/AGE SERIAL NO.	16 HARDWARE CODE
D088893		

PART DISPOSITION

35
1 [ ] REPAIRED IN PLACE
2 [ ] REPAIRED & RE-INSTALLED
3 [ ] ADJUSTED
4 [ ] ELIMINATED
5 [ ] CONDEMNED
6 [ ] HOLD FOR REPAIR
7 [ ] DEPOT REPAIR
8 [X] FAILURE ANALYSIS
9 [ ] USED AS IS

PART REPLACEMENT

36
1 [ ] IDENTICAL ITEM
2 [ ] SUBSTITUTE PART
3 [X] NONE
4 [ ] NONE AVAILABLE

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO: OFR CRIB VNI

40 A-TL

41

FAILURE/OPERATION DATA

17 FAILURE DATE	18 TEST/OPER. DATE	19 TEST/OPER. NO.	20 ITEMS
YR 64 MO. 11 DAY 5	YR 64 MO. 11 DAY 5		1

21 PROCEDURE—SPEC. & PARAGRAPH: 207510-401 PARA. 6.4

22 FB	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS	28 STARTS
23 SV	29 MONTHS	30 INITIAL REPORT NO	31	
24 NC				

32 OPERATION REPORTED OR IN PROGRESS

A [X] COMP/ASSY TEST
B [ ] FINAL ENG. ASSY.
C [ ] ELEC.-MECH. CHECK
D [ ] ACCEPT/R&D TEST
E [ ] STORAGE
F [ ] SHIPPING
G [ ] RECEIVING INSP.
H [ ] MAINTENANCE
I [ ] LEAK & FUNCTION
J [ ] SIM. LAUNCH
K [ ] MISSILE ACCEPT.
L [ ] STAT. MISS. TEST
M [ ] PROPEL. LOADING
N [ ] PERIODIC INSP.

33

34 TIME PERIOD (ACCEPT/R&D/STATIC TEST ONLY)
1 [ ] PRE-TEST
2 [ ] TEST
3 [ ] POST-TEST

REPORTED BY

42 NAME	43 GROUP	44 SUPPLEMENT SHEET
E. ADAMS	388	1 [ ] YES 2 [X] NO
45 APPROVED BY	46 ACTIVITY A8	47 STAND/AREA

ANALYSIS ASSIGNED TO

48 NAME	49 GROUP	50 CODE	51 PART REQ.
W. SMITH	335	AR	[X] YES [ ] NO

DATE REPORT RECEIVED	52 YR. MO. DAY	DATE REPORT DISTRIBUTED	53 YR. MO. DAY

IBM USE ONLY	54 TEST/OPER. NO.	55 1/2 56	57 NTH CODE	58 TAPE CODE

DESCRIPTION OF FAILURE

(WHEN? WHERE? HOW MUCH? CAUSE? EFFECT? COMMENTS?)

AR DUE . RELIABILITY 1/866-204 ---/--/--

⊙FUEL PROP VALVE FAILED DIELECTRIC STRENGTH TEST OF PARAGRAPH 6.4 AT 15°F ENV. TEMP. FOLLOWING COMPLETION OF 50,000 CYCLES OF SERVICE LIFE TESTING. PIN A TO GRD HAD A CURRENT LEAKAGE OF 4000 MICROAMPS WITH AN APPLIED VOLTAGE OF 200. MAXIMUM ALLOWABLE CURRENT LEAKAGE IS 500 MICROAMPS. WITH AN APPLIED VOLTAGE OF 500 VRMS.

71 TEST/OPER. NO. 12981R — 72 A

B

C

D

E

F

G

38 REF. OFR	42 REF. OFR	48 REF. OFR	54 FAILED DETAIL PART NO.

RELIABILITY ANALYSIS USE ONLY

1 IDENTIFICATION	TEST TYPE	10 GROUP RESP. CODE	16 PA. CODE	EF	AP	CF	FC	24 LEAK	CONTAM.	30 PROP. SYSTEM

36 NTH	COMP	40 ASSY	RS-2	CD	46	65 DELETE

1 REPLACEMENT PART NO.	15 REPLACEMENT S/N	22 NAME	25 TYPE	31 MFR.
R-15019-2				

35 INSTALLATION PART NO.	50 CONFIG. CODE	57 NAME	60 GR. RESP.	CH	CL	M	R

51

ORIG. 12981R

FORM 810 © 69 REV. © 69

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY (NAME)	(DEPT. & GROUP)	LOCATION	FAILURE DATE
12981R	E. Adams	896-388	A-8	5 November 1964

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
407662	9183335	Fuel Prop. Valve	Rocketdyne
ENG/AGE MODEL NO.	**ENG/AGE SERIAL NO.**	**TEST/OPERATION NO.**	
SE-7 207510-21	4053579	207510-401	Para. 6.4

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
D. R. Fizz	896-335	11-27-64	1-25-65 / 1/27/65	

FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE:

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE.

1. HISTORY

At the completion of the 15°F Environmental Temperature Test of the noted Thrust Chamber assembly in Design Assurance Testing (D.A.T.), the subject valve failed the Dielectric Strength Test of Paragraph 6.4 of Specification 207510-401. With an applied voltage of 200 volts from pin A to the valve case (ground) a current leakage of 4000 microamps was measured. The maximum allowable current leakage permitted by RA0206-177 with an applied voltage of 500 volts (RMS) is 500 micro-amps. The Thrust Chamber had been subjected, prior to the failure, to thrust vector tests, mission duty cycle, "hot fire" tests, and propellant valve service life tests of 50,000 cycles. The last 20,000 cycles were performed at 15°F.

2. ANALYSIS

Before removing the reported failed valve from the thrust chamber, the following tests were conducted on both the fuel and oxidizer valves:

a) Solenoid resistance, required to be $42 \pm \frac{1}{2}\ \Omega$.

b) Insulation resistance, required to be 500 megΩ minimum when 500 VDC is applied across either pin A to case or pins A to C.

c) Dielectric strength, required to be less than 500 microamps with an applied voltage of 500 VAC (RMS) across either pin A to Case of pins A to C. The results of the tests are as follows:

	Fuel Valve			Oxidizer Valve		
	A-B	A-C	A-Case	A-B	A-C	A-Case
Solenoid Resistance	41.76Ω	—	—	42.28Ω	—	—
Insulation Resistance	—	1000 megΩ	Short	—	1000 megΩ	1000 megΩ
Dielectric Strength	—	4 μ amps	Short	—	4 μ amps	28 μ amps

OFR NO. 12981R

2. ANALYSIS (Continued)

Functional tests were then performed on both valves and consisted of measuring pull-in current, energize time, drop-out current, and de-energize time. The following is a tabulation of normal test requirements per RA0206-177 and test results from both valves:

	Pull-in Current Amps.		Energize Time Sec.		Drop-Out Current Amps	De-Engerize Time, sec.
	@ 0 psig	@ 300 psi	@ 0 psi	@ 300 psi		
Requirement	—	.47 amps max.	—	.023 sec max.	.025 min.	.005 max.
Fuel Valve	.155 amps	.30 amps	.0102	.0235	.032 amps	.0043 sec.
Oxidizer Valve	.140 amps	.31 amps	.0108	.0205	.039 amps	.0049 sec.

Before removal from the thrust chamber, Dielectric strength was again measured. Readings were found to be very erratic in that at 23 volts current leakage was 1000 microamps and at 100 and 101 volts was found to be 32 microamps and 120 microamps, respectively. The valve was then cut from the thrust chamber and the Dielectric Strength again measured at 200 volts, 300 volts, and 400 volts. Current leakage from pin A to the valve case was measured to be 360 microamps, 650 microamps and 960 microsmps, respectively. The casing (riser) around the lead wires was removed from the electrical plug and the valve body. Dielectric strength was then measured and found to be acceptable between pin A and the valve casing but was found unacceptable between pin A and the electrical receptacle. The lead wires were then cut between the valve and electrical plug, and dielectric tests were then performed on the valve and on the receptacle separately. Dielectric strength of the valve body and lead wires was found to be acceptable eliminating the valve as the source or a contributing source of this failure. Again, the electrical receptacle between pin A and the receptacle body was found to be electrically short. Energize time of the valve was again measured and found to be .010 sec. at 0 psi pressure and .0205 at 300 psig pressure exonerating the valve solenoid from any contribution to the reported failure.

As shown in the photograph of Figure IV, the failed electrical receptacle lead wires were very badly charred. The second connector in the same photograph was inserted for a basis of comparison and it also has a slightly charred area in the same position as the first. When aligned with the electrical riser body, the charred area was found to be directly adjacent to the welded hole used to fill the riser with potting compound (Sylgard 183). Also, it can be seen that a black material flowed around the base of the electrical wires at the plug connector body.

Close examination of the charred area in an attempt to determine the failure mode revealed the following:

a. Although severely burned, the wire on pin A was found to have sufficient insulation remaining to prevent electrical conduction between the wire and an electrical probe.

2. ANALYSIS (Continued)

b. The black material which had flowed around the base of the pins at the connector plug body was found to be potting compound (Sylgard 183) in the cured condition.

c. Potting compound had not filled the riser but had only coated the housing.

d. When the black material was carefully removed and the Teflon insulator (Ref. insulation C of Figure I) was severed longitudinally through the burned area, microscopic examination revealed no metallic particles between the pin and the receptacle body.

e. When a dielectric strength test was performed with the charred insulator removed, current leakage was measured to be less than 10 microamps (at 500 volts) across pin A and the receptacle body.

In order to determine the nature and origin of the conductive material that caused the failure, the potting material that was removed from the failed area was probed under a microscope to locate any metallic particles if present. No metallic particles were found. Spectrographic analysis was then conducted on the removed material, the results of which are shown in the tabulation of Figure II. With the spectrographic analysis complete the possible conductive materials and their origins were listed and investigated in order. Figure III tabulates all of the areas investigated.

As shown in the spectrographic analysis a large amount of antimony and tin were found indicating the presence of solder which was seen on the inside of the Teflon insulator (insulation C of Figure I). An abnormal ratio of antimony to tin was found, however, in that the ratio is normally 95:5 but is noted to be 1:48. An explanation of this might be the low boiling point of tin and evaporation during spectrographic sparking. Another source of antimony was suspected to be in the curing agent of the potting compound in the form of a metallic soap, Uncurred potting compound (Sylgard 183) was analyzed and no evidence of any metallics was found.

As part of the investigation, a trip was made to the Crenshaw facility to assess assembly procedures in regard to the failed area. The following pertinent items were noted:

a. Mixing of potting compound is accomplished mainly in metal dishes and metallic stirring utensils are used.

b. Precautions are taken to clean potting compound from the receptacle pins but in several assembly steps before curing, the compound cannot be prevented from entering the critical area.

c. The solder flux (Kester 1544) used in soldering the lead wire to the electrical receptacle came under suspicion since it was believed that the activator ingrediant could leave a conductive residue.

d. The receptacle solder joints are swabbed with cotton or tissue swabs but no inspection has been required to assure that particles of solder or conductive materials have been removed.

2. ANALYSIS (Continued)

e. The noted operations involving soldering and potting are not accomplished in a clean atmosphere.

f. Welding of the potting compound fill hole has successfully been accomplished by machine which would reduce heat applied appreciably.

Since the reported failure occurred after the 15°F portion of the service life test, condensed moisture or just moisture was considered. It was known that the potting compound in the uncured condition is hygroscopic and so an attempt was made to determine the magnitude of this condition. Tests determined that with as little as 0.1 to 0.5%, by weight, of water present in the Sylgard 183 before curing, severe bubbling due to vaporization occurred during curing. It was noted that the potting compound which had flowed into the failure area did not evidence the bubbling condition. In order to determine the amount of water in the air trapped in the riser, calculations were made for 10 cubic centimeters of air at 70°F and a relative humidity of 75%. The amount of water trapped in the riser from the moist air was found to be 2×10^{-4} gm of H_2O. This quantity is believed to be too small to cause the failure by itself. Moisture is also formed when Teflon and potting compound are charred in an evacuated atmosphere, as a product of combustion. All of the mentioned sources of moisture together must be considered as possibly producing a significant amount of moisture to cause or contribute to the failure. It must be noted, however, that the moisture would have to be absorbed into the potting compound or find a crack in the compound, in the failed area, to cause or contribute to the failure. No evidence of moisture was noted during any of the microscopic examinations conducted.

Of the non-metallics considered, the potting compound is definitely non-conductive. If charring occurs, however, in an evacuated or inert atmosphere, free carbon can be produced. This phenomenon also occurs when Teflon is charred in an inert or evacuated atmosphere. If free carbon were produced in this valve, in order to cause or contribute to the failure, the carbon would have to find a crack or separation in the potting compound which had flowed around the failed receptacle pin. As mentioned previously, charring from the closure weld definitely occurred after potting compound curing. If decomposition or reverting of the compound had been caused by welding, the compound would have been in an uncurable liquid condition which was not evidenced.

Also considered was the residue from the solder flux which could remain on the solder joint and be transported into the failed area by the installation of the insulation C of Figure I. The flux material was model 1544 of the Kester Company. Dielectric strength tests conducted on the flux after having been heated to 300°F for ten minutes showed it to be a very good dielectric material.

3. CONCLUSIONS

It may be concluded from the analysis presented herein, that the reported dielectric failure occurred between pin A and the electrical receptacle body inside the riser housing. Also, the conductive material which provided the leak path was not a large readily detectable particle but rather a chain or group of small conductive particles from the following possible sources and held in place by the described flow of uncured potting compound (Sylgard 183):

3. CONCLUSIONS (Continued)

a. Metallic particles injected during potting by either the metallic mixing utensils or from the uncontrolled environment where potting is accomplished.

b. Particles of solder removed and transported by installation of the Teflon sleeve (insulation C of Figure I) aided possibly by overheating at one time producing globules of solder.

c. Moisture produced by condensation of entrapped air, and by charring of the potting compound together could have contributed to or caused the failure if permitted to enter the failed area.

Carbonization of the Sylgard 183 which occurred as a result of burning in evacuated atmosphere would provide a conductive path if accomplished before flowing of potting compound.

In addition, it is concluded that the burned insulation or the burning of the insulation did not directly cause the failure. Excessive heat, however, was required to weld the fill plug and the internal damage resulted.

4. CORRECTIVE ACTION

Since the cause of the failure has not been determined, corrective action has been formulated for the items, which were discussed, which would have caused or contributed to the failure. The following changes are being made to Rocketdyne Process Spacification RA0606-011 (Potting of Solenoid Valve Assemblies) and the expected release date is 15 January, 1965:

a. Metallic mixing utensils will be strictly prohibited and stated so in paragraph 2.3.

b. A paragraph is being inserted in which the solenoid assembly shall be dried in an oven for a minimum of one half hour at 300 $\pm$ 10°F within one hour of filling with potting compound.

c. Paragraph 3.3.1 (potting level) is being made more explicit in that potting shall be a minimum of $\frac{1}{8}$ inch from the vent hole and shall not be permitted to flow around the receptacle at the base of the pins at any time.

Two items which are believed to be prime suspects contributing to the failure are solder and/or air contamination being held in place by the described flow of potting compound. Elimination of the flow of compound into the noted failed area will prevent transporting contamination into the area and will not hold contamination in place when cured. Moving the potting operation into clean room facilities is believed not warranted by the severity of the failure and due to the lack of a firm failure mode.

Excessive heating in welding the fill hole also is believed a prime contributing agent in this failure in that formation of free carbon and moisture from charring are conductive materials. Elimination of the potting compound from the fill hole

4. CORRECTIVE ACTION (Continued)

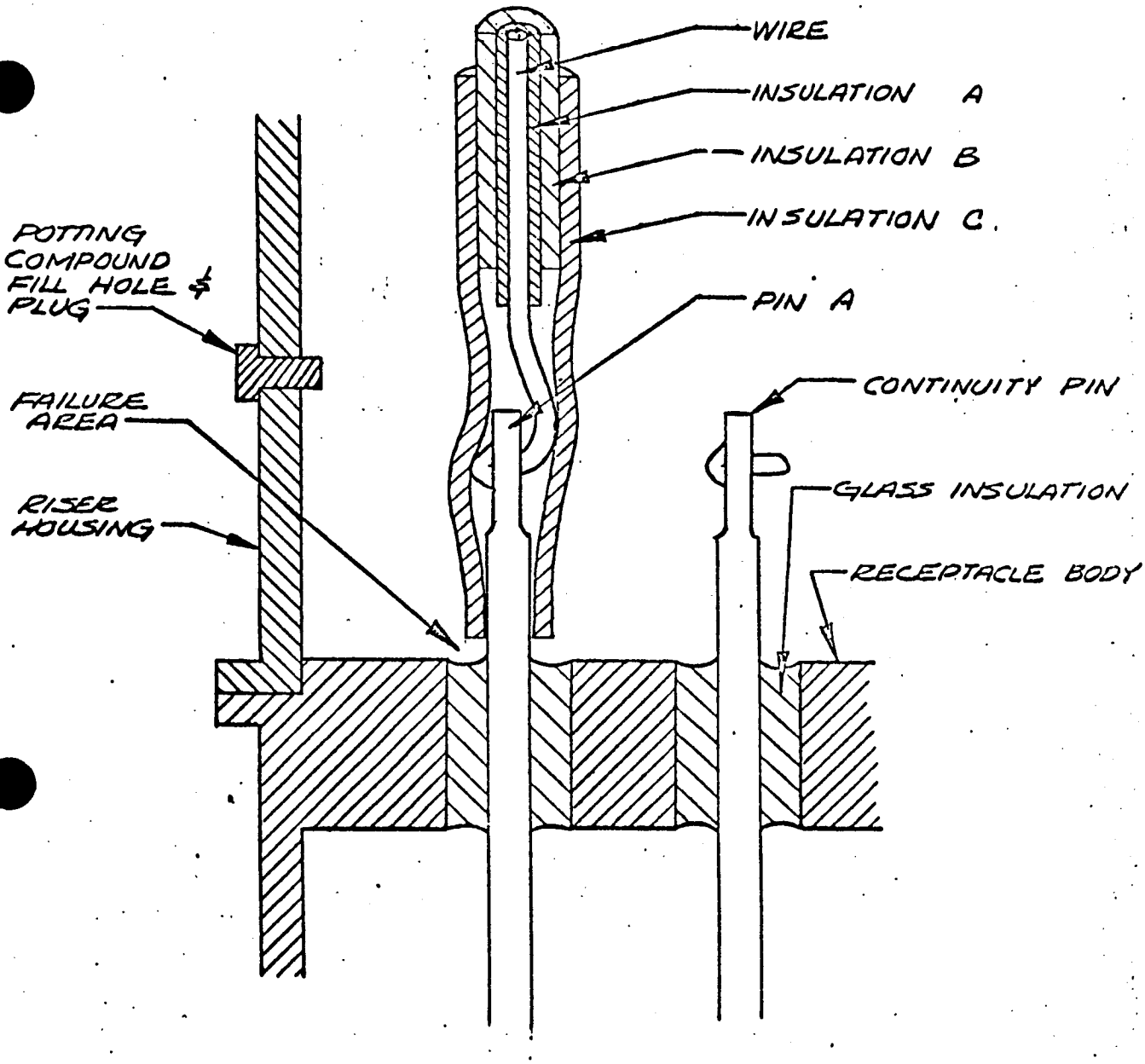
area will reduce the heat requirement considerably and in itself will not produce products of charring. Automatic welding has been successful in welding the vent hole and introducing a minimum amount of heat but the severity of the problem is felt to not warrant the redesign. In addition, a relatively few valves would be affected due to the late date. Reworking would not be warranted nor effective.

Valves already delivered are acceptable for any usage if the dielectric strength remains acceptable. There is no reason to believe that the components may degrade with time and certainly, as evidenced in this failure, valve performance degradation was and should be insignificant.

FAILURE ANALYSIS ACCEPTED	
[signature]	2/17/65
[signature]	2/17/65

RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

PREPARED BY: D.R. FIZZ	ROCKETDYNE A DIVISION OF NORTH AMERICAN AVIATION, INC	PAGE NO. 7 OF 11
CHECKED BY:	FAILURE ANALYSIS REPORT	REPORT NO. OFR 12981R
DATE:	DIELECTRIC FAILURE	MODEL NO. GEMINI



CROSS SECTION OF FAILED AREA

FIGURE I

RESULTS OF SPECTROGRAPHIC ANALYSIS (PERCENT BY WEIGHT)

ELEMENT	FAILURE SAMPLE	NORMAL POTTING COMPOUND
SILICON	6.4	36.0
ANTIMONY	3.7	
TITANIUM	0.70	0.0044
TIN	0.13	
CHROMIUM	0.035	TRACE
LEAD	0.43	
IRON	0.078	0.017
BORON	TRACE	
MAGNESIUM	0.0013	0.0035
MANGANESE	0.0032	
NICKLE	0.032	0.00068
ALUMINUM	0.077	
COPPER	0.0070	0.00013
SILVER	0.0035	
ZINC	0.032	1.0
CALCIUM	0.0021	0.0045
SELINIUM		0.025
ZIRCONIUM		0.00044
LOSS ON IGNITION	79.7	20.7

FIGURE II

TABULATION OF CONDUCTIVE MATERIALS INVESTIGATED

POSSIBLE CONDUCTIVE MATERIALS	TYPE OR FORM	ORIGIN
METALLIC PARTICLES	SOLDER	LOOSENED AND TRANSPORTED INTO THE FAILED AREA BY INSTALLATION OF OUTER INSULATION (SEE FIGURE I)
	METALS PRODUCED BY CHEMICAL COMBINATION-EXCESS ANTIMONY NOTED	BELIEVED THAT METALLIC SOAP USED AS CURING AGENT OF POTTING COMPOUND - DISPROVEN.
	MISCELLANEOUS METAL PARTICLES	PARTICLES FROM SHOP ENVIRONMENT INTRODUCED DURING BUILD OF SOLENOID OR MIXING OF POTTING COMPOUND
		PARTICLES FROM METALLIC MIXING UTENSILS USED TO MIX POTTING COMPOUND.
MOISTURE	ABSORPTION BY POTTING COMPOUND	UNCURED SYLGARD 183 ALTHOUGH HYGROSCOPIC WAS ELIMINATED IN THIS FAILURE BUT IS A CONSIDERATION
	MOIST AIR OR COMPONENTS	MOISTURE BECOME ENTRAPPED UPON WELDING AND CONDENSE AT THE LOW TEMPERATURE. QUANTITY CONSIDERED IS EXTREMLY SMALL.
	CHEMICAL RELEASE	WATER IS PRODUCT OF CHARRING OF THE POTTING COMPOUND (HYDROCARBON)

FIGURE III a

R-15019-2

PREPARED BY: D.R. FIZZ
CHECKED BY:
DATE:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

FAILURE ANALYSIS REPORT

DIELECTRIC FAILURE

PAGE NO. 9 OF 11
REPORT NO. OFR 12993/12
MODEL NO. GEMINI

TABULATION (CONTINUED)

POSSIBLE CONDUCTIVE MATERIALS	TYPE OR FORM	ORIGIN
NON-METALLICS	SOLDER FLUX (KESTER 1544)	RESIDUE NOT REMOVED WITH ALCOHOL SCRUB TRANSPORTED INTO PLACE WITH INSTALLATION OF OUTSIDE INSULATION – TEST INDICATED A GOOD DIELECTRIC
	POTTING COMPOUND	DELIBERATELY PERMITTED TO COVER RECEPTACLE CONNECTIONS ON THIS CONFIGURATION – MATERIAL IS A GOOD DIELECTRIC
	CARBON	CHARRING OF POTTING COMPOUND IN AN INERT OR EVACUATED ATMOSPHERE
		CHARRING OF TEFLON INSULATION IN AN INERT OR EVACUATED ATMOSPHERE

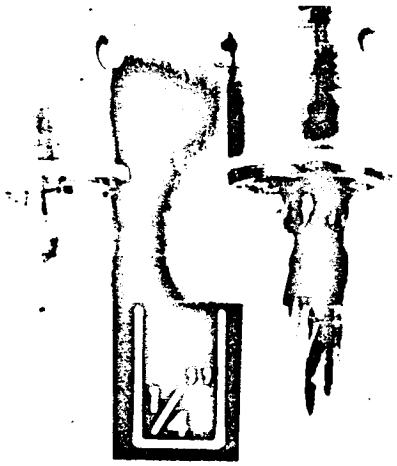
FAILURE ANALYSIS

FUEL PROPELLANT VALVE

DIELECTRIC FAILURE

Normal Receptacle

Slightly Burned



Failed Receptacle

Burned and Blackened Insulation

COMPARISON OF NORMAL AND

FAILED ELECTRICAL RECEPTACLE

FIGURE IV

ROCKETDYNE

PART CHANGE: ☒ FAILED ITEM ☐ TIME EXPIRED ☐ TO DIRECTIVE | SE-7 | III | No. 129233

PART IDENTIFICATION

1 PART NO.	2 PART NAME
207510-21	85 LB. TCA-DAMS

3 SERIAL NO.	4 MFG. NAME	5 MFR. CODE	6 REF. DESIG.
4051206	ROCKETDYNE	02402	

7 NEXT ASSY PART NO.	8 NEXT ASSY SERIAL	9 NEXT ASSY NAME
NONE	NONE	NONE

10 MISSILE SERIAL NO.	11 ENG/AGE MODEL NO.	14 SYSTEM CODE
	SE7	

12 REJ. TAG NO.	13 ENG/AGE SERIAL NO.	15 COMPONENT CODE

16 HARDWARE CODE

PART DISPOSITION

35
1 ☐ REPAIRED IN PLACE
2 ☐ REPAIRED & RE-INSTALLED
3 ☐ ADJUSTED
4 ☐ ELIMINATED
5 ☐ CONDEMNED
6 ☐ HOLD FOR REPAIR
7 ☐ DEPOT REPAIR
8 ☒ FAILURE ANALYSIS
9 ☐ USED AS IS

PART REPLACEMENT

36
1 ☐ IDENTICAL ITEM
2 ☐ SUBSTITUTE PART
3 ☐ NONE
4 ☒ NONE AVAILABLE

37 REPLACEMENT PART NO.

38 REPLACEMENT SERIAL NO.

39 FAILED PART SENT TO: EIGR. STOREROOM

40 C-III

41

FAILURE/OPERATION DATA

17 FAILURE DATE	18 TEST OPER. DATE	19 TEST OPER. NO.	20 ITEMS
YR 64 MO 11 DAY 17	YR 64 MO 11 DAY 7	358/023	1

21 PROCEDURE—SPEC. & PARAGRAPH: 207510-401 / 7.2.3 (DAT)

22 FS	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS	28 STARTS
23 SV			147	22
24 NC	29 MONTHS	30 INITIAL REPORT NO	31	
	10	NONE		

32 OPERATION REPORTED OR IN PROGRESS

A ☐ COMP/ASSY TEST
B ☐ FINAL ENG. ASSY.
C ☐ ELEC.-MECH. CHECK
D ☐ ACCEPT/R&D TEST
E ☐ STORAGE
F ☐ SHIPPING
G ☐ RECEIVING INSP.
H ☐ MAINTENANCE
I ☐ LEAK & FUNCTION
J ☐ SIM. LAUNCH
K ☐ MISSILE ACCEPT.
L ☒ STAT. MISS. TEST
M ☐ PROPEL. LOADING
N ☐ PERIODIC INSP.

33

34 TIME PERIOD (ACCEPT/R&D/STATIC TEST ONLY)
1 ☐ PRE-TEST
2 ☒ TEST
3 ☐ POST-TEST

REPORTED BY

42 NAME	43 GROUP	44 SUPPLEMENT SHEET
E. GANGER	282	1 ☐ YES 2 ☒ NO

45 APPROVED BY	46 ACTIVITY	47 STAND. AREA
[illegible]	29	959

ANALYSIS ASSIGNED TO

48 NAME	49 GROUP	50 CODE	51 PART REQ
R. FIDE	8		☒ YES ☐ NO

DATE REPORT RECEIVED (YR MO DAY)	52	DATE REPORT DISTRIBUTED (YR MO DAY)	53

I&C USE ONLY	54 TEST OPER. NO.	55 1/2	56	57 NTH CODE	58 TAPE CODE

DESCRIPTION OF FAILURE

WHEN? WHERE? HOW MUCH? CAUSE? EFFECT? COMMENTS?

USE RELIABILITY D/C 68-[illegible]

085 LB. DAMS GEMINI TCA, DET UNIT NO. 2, FAILED TO MEET THE THROAT STEADY SHELL SOAKOUT TEMP. REQUIREMENT AFTER THE OCM-217 MDC TO 147 SEC (Y 54 DEG.), 8 MINUTES AFTER CUTOFF. NO INCIPIENT MECHANICAL FAILURE WAS OBSERVED. A CYLINDRICAL TCA RECIRCULATION HEAT SHIELD WAS USED THROUGHOUT THE TEST. ANALYSIS REQUIRED.

71 TEST OPER NO 77: 15700 43 | 78 A

78 B

78 C

78 D

78 E

78 F

78 G

38 REF. OFR	42 REF. OFR	48 REF. OFR	54 FAILED DETAIL PART NO.

RELIABILITY ANALYSIS USE ONLY

1 IDENTIFICATION	TEST TYPE	10 GROUP RESP. CODE	16 PA CODE	EF	AP	CF	FC	24 LEAK	CONTAM	30 PROP SYSTEM

36 NTH	COMP	40 ASSY	RS-2	CD	48	65 DELETE

1 REPLACEMENT PART NO.	18 REPLACEMENT S/N	22 NAME	25 TYPE	31 MFR.

36 INSTALLATION PART NO.	80 CONFIG. CODE	57 NAME	60 GR. RESP.	CH	CL	M	R
R-15019-2							

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FORM 810-C-60 REV. 8-68

A DIVISION OF NORTH AMERICAN AVIATION, INC.

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO.	OFR BY NAME	DEPT. & GROUP	LOCATION	FAILURE DATE
12923R	J. Ganger	896-388	CTL-III	11-18-64

PART IDENTIFICATION

PART NO.	SERIAL NO.	PART NAME	MFR. NAME
207510-21	4051206	Thrust Chamber Assy	Rocketdyne
ENG/AGE MODEL NO.	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	
SE-7		958-093	

ANALYSIS BY

NAME	DEPT. & GROUP	ANALYSIS DATE	APPROVAL	DSN DATE
J. N. Sheingold JNS	896-335	12-18-64		

FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE:

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE.

1. Gemini 85 lb OAMS DAT Unit No. 2 failed to meet soakout temperature requirements following the OCM-217 mission duty cycle test. The temperature recorded was 54 degrees greater than the maximum allowable soakout temperature of 700°F after eight minutes of soakout. A burst pressure test was conducted following the soakout with no structural failure of the part. A cylindrical heat shield was used throughout the test. The test was conducted in the Tri-Mod test facility.

2. Two 85 lb chambers including the subject TCA have been tested to date in the Tri-Mod test facility with a recirculation heat shield. The temperature-time data in both cases has shown the outer shell skin temperature to be approximately 150°F below the allowed mission duty cycle maximum of 500°F at theend of the OCM-217 MDC. The first chamber tested, however, had no soakout requirement.

Examination of the heat shield used showed the inner surface to be shiny which from a heat transfer standpoint would be highly reflective.

A heat transfer analysis was performed comparing the radiation heat loss during soakout using the heat shield as tested and the Tri-Mod housing without the shield. The analysis indicated that during soakout, the reflective nature of the heat shield in conjunction with its close proximity to the TCA shell effectively reduced the radiant heat transfer from the TCA shell.

3. The overtemperature experienced during soakout was seen to be the direct result of the reduction of radiant heat transfer from the TCA skin to the environment caused by the reflective nature and also the proximity to the TCA of the heat shield.

4. No corrective action is required since no further requirements exist for 85 lb thrust chamber MDC testing through S/C 5.

A heat shield will be used for S/C 6 85 lb chambers, however. For these tests the shield inner surface will be painted a dull balck and the outer surface heated to eliminate the reduction in TCA radiant heat transfer.

MAC SUGGESTS THE PRESENT STAINLESS STEEL TABLE BE WATER COOLED TO PREVENT HEAT TRANSFER. THIS WOULD PROVIDE A REALISTIC SPACECRAFT INSTALLATION ENVIRONMENT.

FAILURE ANALYSIS ACCEPTED

[signature]	2/1/65
[signature]	2/1/65

R-15019-2

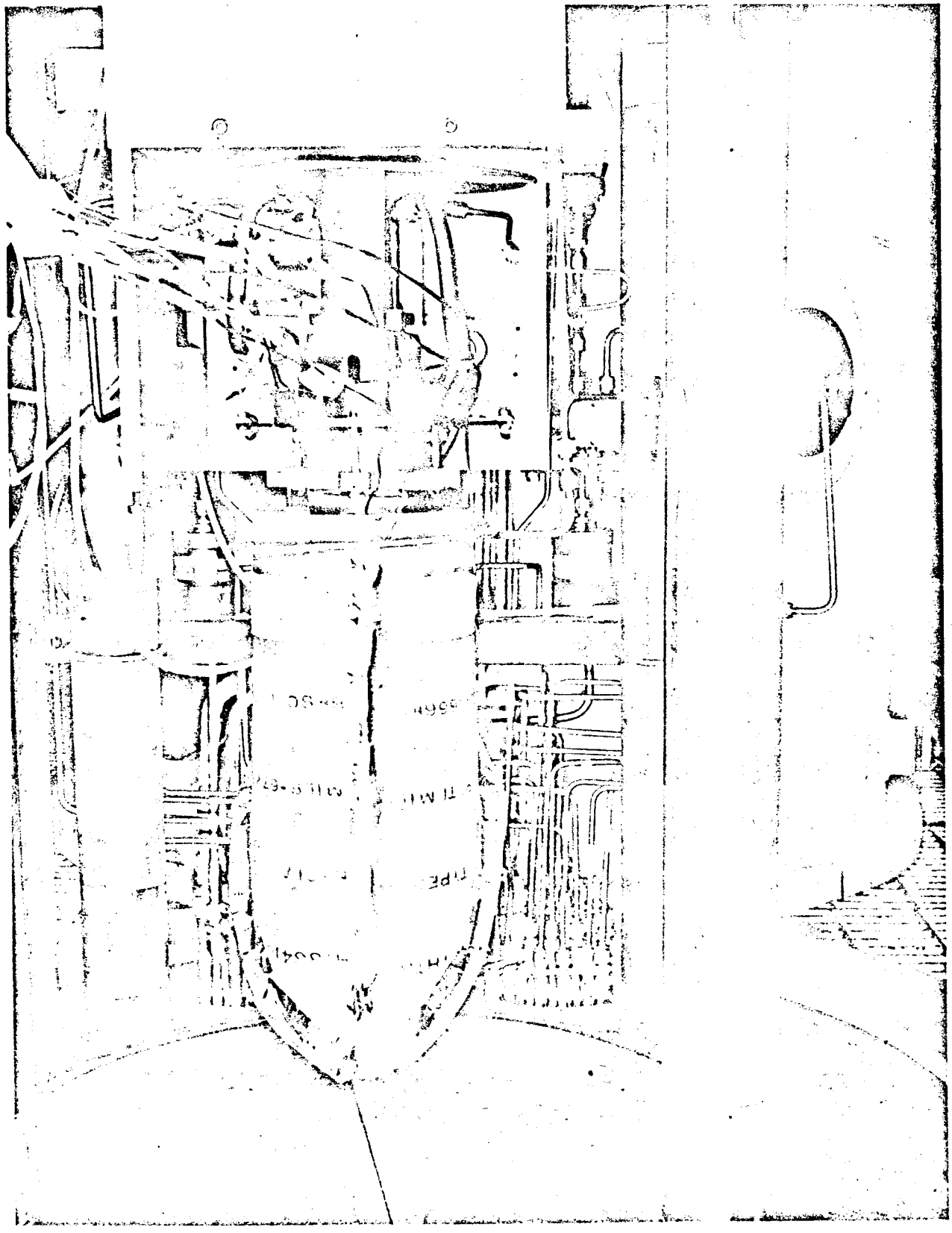
RELIABILITY DEPT. 261
McDONNELL AIRCRAFT CORP.

OFR NO. 12923R

Ltr 31 52-52-191

FORM 609 P-2 REV. 2-62 64

pg 1 of 2



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APPENDIX C

MODULE/COMPONENT LOG BOOK AND ACCEPTANCE TEST DATA

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~~CONFIDENTIAL~~ SCD 52-52701-275
S/N 4051207

R-15019-2

"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE DAT #2 (CRD #6)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
DATE 8/11/64	DATE 8/11/64	DATE 8-11-64	DATE 11 Aug 1964

CONTENTS

SECTION I – DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION DATA, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II – ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKETDYNE AND USING AGENCIES.

GROUP-4

Downgraded at 3 year intervals;
declassified after 12 years

ROCKETDYNE – SPACE ENGINES
A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKETDYNE
THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C. SECTIONS 793 AND 794, ITS TRANSMISSION OR REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	11 AUGUST 1964
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-275	SPEC NO	
DNA	SERIAL NO	4051207
52-52701-275	PART NO	207510-21

SE-7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER ASSY, 85 LB.

1.0

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~~CONFIDENTIAL~~

DELIVERABLE END ITEM

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM AS SPECIFIED HEREIN BY SERIAL NUMBER AND PART NUMBER. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

	DNA SERIAL NO. 4051207
	52-52701-275 PART NO. 207510-21
FOREWORD--SE-7 LOG BOOK	PART NAME THRUST CHAMBER ASSY, 85 LBS. 2.0

R-15019-2

1.0 LOG BOOK IDENTIFICATION

2.0 FOREWORD

3.0 CONTENTS

4.0 MODULE/COMPONENT ASSEMBLY LOG--SECTION I

4.1 CONFIGURATION & SERIALIZATION LOG

4.2 MCR VERIFICATION

4.3 VARIATION LOG

4.4 REPLACEMENT LOG

5.0 COMPONENT ACCEPTANCE TEST LOG--SECTION II

5.1 COMPONENT ACCEPTANCE TEST

5.1.1 COMPONENT ACCEPTANCE TEST

5.1.2 COMPONENT ACCEPTANCE TEST

5.1.3 COMPONENT ACCEPTANCE TEST

5.1.4 COMPONENT ACCEPTANCE TEST

5.1.5 COMPONENT ACCEPTANCE TEST

5.2 CALIBRATED PERFORMANCE DATA

5.2.1 CALIBRATED PERFORMANCE DATA

5.2.2 CALIBRATED PERFORMANCE DATA

5.3 INFORMATION--CONTAMINATION

52-52701-275 PART NO. 207510-21

CONTENTS--SE-7 LOG BOOK

PART NAME THRUST CHAMBER ASSEMBLY, 85 LBS.

3.0

SECTION I

	52-52701-275 PART NO. 207510-21
SE-7 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER ASSY, 85 LBS. 4.0

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE7-041	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLUES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGE TO 304L BAR PER QQ-S-763	11 AUG 64	ANR 142
SE7-085	30 APR 64	85 & 100 LB. TCA DIMENSIONS; CHANGES TO	11 AUG 64	ANR 142
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	11 AUG 64	ANR 142
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	11 AUG 64	ANR 142
SE6-075	2 JUL 64	MAC REPORT 8518, INCORPORATION OF	11 AUG 64	ANR 142
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	11 AUG 64	ANR 142
SE6-085	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	11 AUG 64	ANR 142
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	11 AUG 64	ANR 142
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	11 AUG 64	ANR 142
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	11 AUG 64	ANR 142
SE6-179	16 JUN 64	TUBE STUBS; MARKING OF	11 AUG 64	ANR 142

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DNA 52-52701-275 SERIAL NO. 4051207 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM - MCR VERIFICATION

PART NAME THRUST CHAMBER ASSY, 85 LBS. 4.2

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
74	207510-21	DNA	THRUST CHAMBER,	4051207	3 Q 63	
	207511-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4057815	3 Q 63	
	207518	DNA	SHELL, THRUST CHAMBER, ASSY OF	8501817		
	207525	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4059259		
	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	4057605		
	407662	DNA	VALVE, FUEL, T/C, ASSY OF	4057623		

R-15019-2

DNA SERIAL NO. 4051207

52-52701-275 PART NO. 207510-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER ASSY, 85 LBS.

4.1

IR-15019-2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
MRR #56411	SE-7	207510-21	4051207	DISCREPANCY: REF: B/P 207518 ZONE 5 .040 LOCATION DIM. OF -7 TAB CHECKS .139 (.089 OVER TOL.) DISPOSITION: ACCEPTABLE TO USE FOR DAT PER MRR #56411 REF. 23-H #R16571	ANR 645
MRR #56424	SE-7	207510-21	4051207	DISCREPANCY: CONDITION A: TAB IS OFF THE CENTERLINE .063 FROM THE FUEL VALVE SIDE. (REF. PLAN VIEW ZONE 4. CONDITION B: THE 3.600 + -.010 DIM. IS FROM 3.566 TO 3.586. (ZN. 3). CONDITION C: PRIOR TO HOT FIRE TESTING THE MMH SAMPLE #253 WAS TAKEN AND ACCEPTABLE AFTER HOT FIRE TEST, MMH TEST #255 DID NOT MEET SPEC. REQUIREMENTS. ON #255 THE ANALYSIS WAS AS FOLLOWS: MMH -97.6% (PER MIL-P-27404 S/B 98.0%); H_2O -2.4% (S/B 2.0%). 600N-5 #C 17385. DISPOSITION: ACCEPTABLE TO USE FOR DAT PER MRR #56424 REF. 600N-5 #C17385	ANR 645

75

DNA SERIAL NO. 4051207

52-52701-275 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER ASSEMBLY, 85 LBS. 4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE 11 AUGUST 64			

R-15019-2

DNA
52-52701-275

SERIAL NO. 4051207
PART NO. 207510-21

SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG

PART NAME THRUST CHAMBER ASSY, 85 LBS.

4.4

R-15019-2

SECTION II

52-52701-275 PART NO. 207510-21

SE-7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER ASSY, 85 LBS. 5.0

78 PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	72	ANR 645
FUEL	4.2.11	DEGREES F	70 ± 5	72	ANR 645
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	40.010	ANR 645
FUEL	4.2.11	OHMS	42 ± 2	41.580	ANR 645
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.053	ANR 645
FUEL	4.2.11	OHMS	1.0 MAX.	.030	ANR 645
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	68	ANR 645
FUEL	4.3.11	MICROAMPS	500 MAX.	65	ANR 645
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500	VERIFIED	ANR 645
STEP II	4.4.5	PSIG	500	VERIFIED	ANR 645

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SPECIFICATION NUMBER	REVISION	AMENDMENT	DNA	SERIAL NO.	
RA0220-348	A	NONE	52-52701-275	PART NO.	207510-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER ASSY, 85 LBS. 5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
R-1501G-2 PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	ANR 645
STEP II	4.4.7	PSIG	500	VERIFIED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 645

79 SPECIFICATION NUMBER RA0220-348 REVISION A AMENDMENT NONE

DNA SERIAL NO. 4051207

52-52701-275 PART NO. 207510-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER ASSY, 85 LBS.

5.1.1

80 PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT					
STEP I	4.5.8	PSIG	392 ± 10	VERIFIED	ANR 645
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	ANR 645
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.5.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.0164	ANR 645
FUEL	4.6.8	SEC.	0.021 MAX.	.0166	ANR 645
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0030	ANR 645
FUEL	4.6.10	SEC.	0.005 MAX.	..0028	ANR 645
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	1.75	ANR 645
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.75	ANR 645

R-1501-2

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-348	A	NONE	DNA	SERIAL NO.	4051207
			52-52701-275	PART NO.	207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER ASSY, 85 LBS.	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.53	ANR 645
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.233	ANR 645
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.672	ANR 645
B-B		INCH	DNA	.672	ANR 645
C-C		INCH	DNA	.672	ANR 645
D-D		INCH	DNA	.672	ANR 645
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	8.32	ANR 645
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

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SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	A	NONE	DNA	SERIAL NO. 4051207
			52-52701-275	PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER ASSY, 85 LBS.	5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
POST HOT-FIRE DATA (CONTINUED)					
PROOF PRESSURE TEST					
STEP I	4.14.5	PSIG	392 ± 10	VERIFIED	ANR 645
STEP II	4.14.5	PSIG	392 ± 10	VERIFIED	ANR 645
LEAKAGE TEST THRUST CHAMBER					
STEP I	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
LEAKAGE TEST--TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
FUEL	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
LEAK TEST--WELDED JOINTS					
LEAK TEST					
PRESSURIZED INLET TUBE WITH GASEOUS HELIUM					
OXIDIZER	4.14.6	PSIG	500 ± 10	VERIFIED	ANR 645
FUEL	4.14.9	PSIG	500 ± 10	VERIFIED	ANR 645

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-348	A	NONE	DNA	SERIAL NO.	4051207
			52-52701-275	PART NO.	207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER ASSEMBLY, 85 LBS.	5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
R-15019-2					
LEAK TEST--WELDED JOINTS (CONTINUED)					
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	5.8×10^{-8}	ANR 645
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	9.0×10^{-7}	ANR 645
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.224	ANR 645
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.672	ANR 645
B-B		INCH	DNA	.672	ANR 645
C-C		INCH	DNA	.672	ANR 645
D-D		INCH	DNA	.672	645
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.36	ANR 645
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANR 645

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 197 TEST DATA	RUN ******* TEST DATA	RUN ****** TEST DATA	RUN 198 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE			NFL			NFL	
CELL LOCATION			1-A			1-A	
CELL NUMBER			379			379	
TEST DATE			13 July 64			14 July 64	
TEST DURATION	SEC.		3.0			3.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX	.06800			.07060	
AMBIENT PRESSURE	PSIA	DNA	12.05			12.07	
AMBIENT TEMPERATURE	^{o}F	DNA	74.0			62.0	
TIME OF DATA SLICE-START	SEC.	DNA	2.8			2.8	
TIME OF DATA SLICE-END	SEC.	DNA	2.8			2.8	
OXIDIZER TEMPERATURE	^{o}F	DNA	67.1			60.7	
FUEL TEMPERATURE	^{o}F	DNA	69.5			60.5	
OXIDIZER DENSITY	LB/FT^3	DNA	91.11			91.53	
FUEL DENSITY	LB/FT^3	DNA	54.71			54.56	

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SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-348	A	NC	DNA 52-52701-275	SERIAL NO. 4051207 PART NO. 207510-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 85LB ASSY

5.2

CONFIDENTIAL

[redacted] THE NATIONAL DEFENSE [redacted] STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, [redacted] TITLE 18, SECTIONS [redacted] AS AMENDED. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

~~GROUP 4~~
~~Downgraded at 3 year intervals;~~
~~declassified after 12 years~~

R-15019-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 197 TEST DATA	RUN ***** TEST DATA	RUN****** TEST DATA	RUN 198 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE			NFL			NFL	
OXIDIZER INLET PRESSURE	PSIA	285 ± 10	290.1			290.4	
FUEL INLET PRESSURE	PSIA	287 ± 10	288.6			287.0	
OXIDIZER FLOWRATE	LB/SEC	DNA	.1642			.1638	
FUEL FLOWRATE	LB/SEC	DNA	.1017			.1008	
THRUST	LB.	DNA	78.6			77.9	
MIXTURE RATIO	O/F	DNA	1.61			1.63	
SPECIFIC IMPULSE	SEC	DNA	296.			295.	
INJECTOR END Pc	PSIA	DNA	123.7			127.0	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5308.			5475.	
THROAT DIAMETER	INCH	DNA	.672			.672	
FUEL ORIFICE DIAMETER	INCH	DNA	.06500			.06500	
OXIDIZER ORIFICE DIAMETER	INCH	DNA	.07210			.07210	
TCA FIRING TIME (TOTAL)	SEC	10 MAX.	3.0			6.0	
OXIDIZER SAMPLE NUMBER			252.			252.	
FUEL SAMPLE NUMBER			253.			253.	

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SPECIFICATION NUMBER	REVISION	AMENDMENT
RAO 220-348	A	NC

DNA SERIAL NO. 4051207
52-52701-275 PART NO. 207510-21

SE-7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 85 LB ASSY

5.2.1

~~GROUP 4~~
~~Downgraded at 3 year intervals;~~
~~declassified after 12 years~~

CONFIDENTIAL

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE [illegible] AS AMENDED. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

GROUP 4
Downgraded at 3 year intervals:
declassified after 12 years

86 CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 197 TEST DATA	RUN ******* TEST DATA	RUN ****** TEST DATA	RUN 198 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE			NFL			NFL	
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	79 ± 3.9	78.6			77.9	
MIXTURE RATIO	O/F	1.6 ± .05	1.59			1.58	
SPECIFIC IMPULSE	SEC	DNA	299.			298.	
INJECTOR END Pc	PSIA	DNA	122.2			125.3	
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5300.			5462.	
ADJUST TO RATED CONDITIONS							
THRUST	LB.	79 ± 3.9	79.0			79.0	
MIXTURE RATIO	O/F	1.6 ± .05	1.60			1.60	
SPECIFIC IMPULSE	SEC	280 MIN.	299.			298.	

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SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-348	A	NC	DNA 52-52701-275	SERIAL NO. 4051207 PART NO. 207510-21
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER 85 LB ASSY	5.2.2

GROUP 4
Downgraded at 3 year intervals:
[illegible]

R-15019-2

THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

		LIMITS	ACTUAL COUNT MMH - FUEL	ACTUAL COUNT NTO - OXID
	< 10	*	60	57
	10 - 25	100	10	8
	25 - 50	20	0	1
	50 - 100	5	0	1
	100 - 300	1	0	0
	300 - 1000	0	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	0	0	0
FIBERS	> 3000	0	0	0

* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG).

CLASS 4

INSP. ANR 645

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SPECIFICATION NUMBER	REVISION	AMENDMENT	
RA0615-003	B	#2	52-52701-275 PART NO. 207510-21
SE-7 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER ASSEMBLY, 85 LB. 5.3

SCD 52-52701-275
S/N 4051206

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"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE DAT #1 (CRD #5)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
[signature]	[signature]	[signature]	[signature] HFQA
DATE 8-13-64	DATE 13 Aug. 64	DATE 13 Aug. 64	DATE 8-13-64

CONTENTS

SECTION I – DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION DATA, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II – ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKETDYNE AND USING AGENCIES.

GROUP-4
Downgraded at 3 year intervals;
declassified after 12 years

ROCKETDYNE – SPACE ENGINES
A DIVISION OF NORTH AMERICAN AVIATION, INC.

R-15019-2

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKETDYNE
THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C. SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	10 AUG 64
	DWG CHG LTR	DNA
Y20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD 52-52701-275	SPEC NO.	
DNA	SERIAL NO.	4051206
52-52701-275	PART NO.	207510-21

SE-7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION | PART NAME THRUST CHAMBER, 85 LB., ASSY OF | 1.0

R-15019-2

1.0 LOG BOOK IDENTIFICATION

2.0 FOREWORD

3.0 CONTENTS

4.0 MODULE/COMPONENT ASSEMBLY LOG--SECTION I

4.1 CONFIGURATION & SERIALIZATION LOG

4.2 MCR VERIFICATION

4.3 VARIATION LOG

4.4 REPLACEMENT LOG

5.0 COMPONENT ACCEPTANCE TEST LOG--SECTION II

5.1 COMPONENT ACCEPTANCE TEST

5.1.1 COMPONENT ACCEPTANCE TEST

5.1.2 COMPONENT ACCEPTANCE TEST

5.1.3 COMPONENT ACCEPTANCE TEST

5.1.4 COMPONENT ACCEPTANCE TEST

5.1.5 COMPONENT ACCEPTANCE TEST

5.2 CALIBRATED PERFORMANCE DATA

5.2.1 CALIBRATED PERFORMANCE DATA

5.2.2 CALIBRATED PERFORMANCE DATA

5.3 INFORMATION--CONTAMINATION

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52-52701-275 PART NO. 207510-21

CONTENTS--SE-7 LOG BOOK

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

3.0

DELIVERABLE END ITEM

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM AS SPECIFIED HEREIN BY SERIAL NUMBER AND PART NUMBER. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

	DNA SERIAL NO. 4051206 52-52701-275 PART NO. 207510-21	
FOREWORD--SE-7 LOG BOOK	PART NAME THRUST CHAMBER, 85 LB., ASSY OF	2.0

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SECTION I

52-52701-275 PART NO. 207510-21

SE-7 MODULE / COMPONENT ASSEMBLY LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	207510-21	DNA	THRUST CHAMBER, 85 LB., ASSY OF	4051206	1 Q 64	ANR 721
2	207511-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4059330	1 Q 64	ANR 721
2	207518	DNA	SHELL, THRUST CHAMBER, ASSY OF	8501820		ANR 1-2
3	207525	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	4058119		ANR 721
2	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	4054991		ANR 721
2	407662	DNA	VALVE, FUEL, T/C, ASSY OF	4051671		ANR 721

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DNA SERIAL NO. 4051206

52-52701-275 PART NO. 207510-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.1

NCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	11 AUG 64	ANR 645
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	11 AUG 64	ANR 645
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	11 AUG 64	ANR 645
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	11 AUG 64	ANR 645
SE6-179	16 JUN 64	TUBE STUBS; MARKING OF	11 AUG 64	ANR 645
SE7-041	15 APR 64	85# AND 100" THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES, MATERIAL; CHANGES TO 304L BAR PER QQ-S-763	11 AUG 64	ANR 645
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	11 AUG 64	ANR 645
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	11 AUG 64	ANR 645
SE7-085	30 APR 64	85 & 100 LB. TCA DIMENSIONS; CHANGES TO	11 AUG 64	ANR 645
SE6-085	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENTS FOR	11 AUG 64	ANR 645

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DNA 52-52701-275 SERIAL NO. 4051206 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM - NCR VERIFICATION

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
MAC MRR #58779	THRUST CHAMBER 85 LB., ASSY OF	207510-21	4051206	DISCREPANCY: CONDITION A: 1ST LINER DOWNSTREAM FROM THE INJECTOR IS CRACKED. CRACK EXTENDS FROM UPSTREAM TO DOWNSTEAM EDGES ACROSS THE P/C HOLE. MAX. WIDTH OF CRACK IS .003. SEE PAGE 2 OF 2 REF: 600N-5 C17389. CONDITION B: PRIOR TO HOT FIRE TESTING MMH SAMPLE #253 WAS TAKEN AND ANALYSIS WAS ACCEPTABLE. AFTER TESTING MMH SAMPLE #255 DID NOT MEET SPEC REQUIREMENTS. MMH WAS 97.6%, H_2O WAS 2.4%, S/B 98%, MAX. H_2O OF 2%, PER MIL-P-27404. REF: 600N-5 C17389. DISPOSITION: DISCREPANCY IS NOT CONSIDERED SUFFICIENT TO MATERIALLY AFFECT THE PHYSICAL AND FUNCTIONAL DESIGN REQUIREMENTS, THEREFORE, ACCEPTABLE TO USE FOR SYSTEM DAT. A FAILURE OF THIS UNIT IN SYSTEM DAT SHALL NOT BE ATTRIBUTED TO THESE DISCREPANCIES.	AMR 721
MAC MRR #58779 NOR #1	THRUST CHAMBER 85 LB., ASSY OF	207510-21	4051206	DISCREPANCY: THIS NOR#1 IS WRITTEN TO CORRECT REFERENCED 600N NUMBERS PAGE 1 OF MAC MRR 58779 LINE 3 READS REF: 600N-5 C17288 AND SHOULD READ 600N-5 C17389. PAGE #2 OF MAC MRR 58779 (UPPER RIGHT CORNER) READS C17289 AND SHOULD READ C17389. DISPOSITION: ACCEPTABLE AS IS.	AMR 721

DNA 52-52701-275 SERIAL NO. 4051206 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE (10 AUG 64) (ARM 142)			

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DNA SERIAL NO. 4051206

52-52701-275 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.4

SECTION II

52-52701-275 PART NO. 207510-21

SE-7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
R-15019-2 ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	69	ANR 721
FUEL	4.2.11	DEGREES F	70 ± 5	69	ANR 721
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	41.74	ANR 721
FUEL	4.2.11	OHMS	42 ± 2	41.36	ANR 721
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.167	ANR 721
FUEL	4.2.11	OHMS	1.0 MAX.	.132	ANR 721
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	48	ANR 721
FUEL	4.3.11	MICROAMPS	500 MAX.	51	ANR 721
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500	VERIFIED	ANR 721
STEP II	4.4.5	PSIG	500	VERIFIED	ANR 721

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SPECIFICATION NUMBER RA0220-348	REVISION "A"	AMENDMENT NONE	DNA 52-52701-275	SERIAL NO. 4051206 PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1

98 PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	ANR T21
STEP II	4.4.7	PSIG	500	VERIFIED	ANR T21
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANR T21
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANR T21
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR T21
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR T21

R-1501-2

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-348	"A"	NONE	DNA	SERIAL NO.	4051206 A
			52-52701-275	PART NO.	207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 85 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT					
STEP I	4.5.8	PSIG	392 ± 10	VERIFIED	ANR 721
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	ANR 721
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
STEP II	4.5.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	NONE DETECTED	ANR 721
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.0180	ANR 721
FUEL	4.6.8	SEC.	0.021 MAX.	.0185	ANR 721
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0033	ANR 721
FUEL	4.6.10	SEC.	0.005 MAX.	.0036	ANR 721
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	2	ANR 721
FUEL	4.6.13	VOLT (DC)	1 MIN.	2	ANR 721

R-15019-2

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SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	"A"	NONE	DNA 52-52701-275	SERIAL NO. 4051206 PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1.2

100 PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 721
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 721
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.58	ANR 721
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.225	ANR 721
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.673	ANR 721
B-B		INCH	DNA	.673	ANR 721
C-C		INCH	DNA	.673	ANR 721
D-D		INCH	DNA	.673	ANR 721
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	8.60	ANR 721
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

R-15019-2

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	A	NONE	DNA	SERIAL NO. 4051206
			52-52701-275	PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
R-15019-2					
POST HOT-FIRE DATA (CONTINUED)					
PROOF PRESSURE TEST					
STEP I	4.14.5	PSIG	392 ± 10	VERIFIED	ANR 645
STEP II	4.14.5	PSIG	392 ± 10	VERIFIED	ANR 645
LEAKAGE TEST THRUST CHAMBER					
STEP I	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
STEP II	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.14.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
LEAKAGE TEST--TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
FUEL	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
LEAK TEST--WELDED JOINTS					
LEAK TEST					
PRESSURIZED INLET TUBE WITH GASEOUS HELIUM					
OXIDIZER	4.14.6	PSIG	500 ± 10	VERIFIED	ANR 645
FUEL	4.14.9	PSIG	500 ± 10	VERIFIED	ANR 645

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SPECIFICATION NUMBER RA0220-348 | REVISION A | AMENDMENT NONE

DNA 52-52701-275 | SERIAL NO. 4051206 | PART NO. 207510-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	2.9×10^{-8}	ANR 645
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	9.1×10^{-7}	ANR 645
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	NONE DETECTED	ANR 645
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.248	ANR 645
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.6740	ANR 645
B-B		INCH	DNA	.6720	ANR 645
C-C		INCH	DNA	.6735	ANR 645
D-D		INCH	DNA	.6740	ANR 645
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.38	ANR 645
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	NONE DETECTED	ANR 645

SPECIFICATION NUMBER	REVISION	AMENDMENT			
RA0220-348	A	NONE	DNA	SERIAL NO.	4051206
			52-52701-275	PART NO.	207510-21
SE - 7 COMPONENT ACCEPTANCE TEST			PART NAME	THRUST CHAMBER, 85 LB., ASSY OF	5.1.5

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 169 TEST DATA	RUN 187 TEST DATA	RUN TEST DATA	RUN 199 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	-	-
CELL LOCATION	-	-	1-A	1-A	-	1-A	
CELL NUMBER	-	-	379	379	-	379	
TEST DATE	-	-	12 June 64	24 June 64	-	15 July 64	
TEST DURATION	SEC.	10 MAX.	3.0	3.0	-	3.0	
ENVIRONMENTAL Pc	PSIA	0.16 MAX.	.06860	.06220	-	0.06440	
AMBIENT PRESSURE	PSIA	DNA	12.08	12.03	-	12.24	
AMBIENT TEMPERATURE	^{o}F	DNA	62.0	80.0	-	78.0	
TIME OF DATA SLICE-START	SEC.	DNA	2.8	2.8	-	2.8	
TIME OF DATA SLICE-END	SEC.	DNA	2.8	2.8	-	2.8	
OXIDIZER TEMPERATURE	^{o}F	DNA	59.5	70.5	-	77.3	
FUEL TEMPERATURE	^{o}F	DNA	61.0	71.0	-	76.4	
OXIDIZER DENSITY	LB/FT^3	DNA	91.85	91.01	-	90.63	
FUEL DENSITY	LB/FT^3	DNA	55.23	55.20	-	54.43	

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RAO 220-348	A	NC	DNA 52-52701-275	SERIAL NO. 4051206 PART NO. 207510-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 85 LB ASSY OF

5.2

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GROUP 4
Downgraded at 3 year intervals:
declassified after 12 years

THE NATIONAL DEFENSE OF THE U[illegible] STATES WITHIN THE MEANING OF THE [illegible] LAWS, [illegible] TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 169 TEST DATA	RUN 187 TEST DATA	RUN TEST DATA	RUN 199 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	-	-
OXIDIZER INLET PRESSURE	PSIA	285 ± 10	281.7	288.9	-	288.6	ANR 965
FUEL INLET PRESSURE	PSIA	287 ± 10	276.3	288.1	-	287.1	[illegible]
OXIDIZER FLOWRATE	LB/SEC	DNA	.1644	.1649	-	.1660	[illegible]
FUEL FLOWRATE	LB/SEC	DNA	.1009	.1040	-	.1020	ANR 965
THRUST	LB.	DNA	76.3	76.8	-	77.1	[illegible]
MIXTURE RATIO	O/F	DNA	1.63	1.59	-	1.63	[illegible]
SPECIFIC IMPULSE	SEC	DNA	287.	286.	-	288.	[illegible]
INJECTOR END Pc	PSIA	DNA	121.1	122.6	-	124.5	[illegible]
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5225.	5220.	-	5317.	[illegible]
THROAT DIAMETER	INCH	DNA	.673	.673	-	.673	ANR 965
FUEL ORIFICE DIAMETER	INCH	DNA	.06485	.06485	-	.06485	[illegible]
OXIDIZER ORIFICE DIAMETER	INCH	DNA	.07185	.07185	-	.07185	[illegible]
TCA FIRING TIME (TOTAL)	SEC	10 MAX.	3.0	6.0	-	9.0	ANR 965
OXIDIZER SAMPLE NUMBER	-	-	235.	243.	-	252.	[illegible]
FUEL SAMPLE NUMBER	-	-	236.	244.	-	253.	[illegible]

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SPECIFICATION NUMBER	REVISION	AMENDMENT
RAO 220-348	A	NC

DNA SERIAL NO. 1051206
52-52701-275 PART NO. 207510-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 85 LB ASSY OF

5.2.

CONFIDENTIAL
GROUP 4
Downgraded at 3 year intervals:
declassified after 12 years

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GROUP 4
Downgraded at 3 year intervals:
declassified after 12 years

THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

R-15019-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 169 TEST DATA	RUN 187 TEST DATA	RUN TEST DATA	RUN 199 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	NFL	NFL	-	NFL	ANR 995
ADJUST TO STANDARD CONDITIONS	-	-	-	-	-	-	-
THRUST	LB.	79.0 ± 3.9	77.7	76.8	-	77.5	ANR 995
MIXTURE RATIO	O/F	1.60 ± .05	1.58	1.57	-	1.60	ANR 995
SPECIFIC IMPULSE	SEC	DNA	290.	289.	-	291.	ANR 995
INJECTOR END Pc	PSIA	DNA	121.9	121.3	-	123.6	ANR 995
CHARACTERISTIC VELOCITY	FT/SEC	DNA	5212.	5215.	-	5309.	ANR 995
ADJUST TO RATED CONDITIONS	-	-	-	-	-	- -	-
THRUST	LB.	79.0	79.0	79.0	-	79.0	ANR 995
MIXTURE RATIO	O/F	1.60	1.60	1.60	-	1.60	ANR 995
SPECIFIC IMPULSE	SEC	280 MIN.	291.	289.	-	291.	ANR 995

SPECIFICATION NUMBER	REVISION	AMENDMENT
RAO 220-348	A	NC
RAO 220-231	N/C	#2

DNA SERIAL NO. 4051206

52-52701-275 PART NO. 207510-21

SE-7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER 85 LB ASSY OF

5.2.2

GROUP 4
Downgraded at 3 year intervals:
declassified after 12 years

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THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

		LIMITS	ACTUAL COUNT MMH - FUEL	ACTUAL COUNT NTO - OXID
	< 10	*	DNA	DNA
	10 - 25	100	69	17
	25 - 50	20	11	3
	50 - 100	5	2	0
	100 - 300	1	1	0
	300 - 1000	0	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	0	0	0
FIBERS	> 3000	0	0	0

* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG).

CLASS 4

INSP. ANR 6-25

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0615-003	B	#1	52-52701-275 PART NO. 207510-21	
SE-7 INFORMATION - CONTAMINATION			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.3

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SCD52-52701-275

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"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE

SPACE ENGINES ~~ENGINEERING~~	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
Alan D. Lolland	[signature]	[signature]	L. L. Burrow
DATE 6/11/64	DATE 11 June 64	DATE 11 June 64	DATE 11 June 1964

CONTENTS

SECTION I – DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION DATA, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II – ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKETDYNE AND USING AGENCIES.

GROUP-4

Downgraded at 3 year intervals;
declassified after 12 years

ROCKETDYNE – SPACE ENGINES
A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKETDYNE
THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U. S. C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	10 JUNE 1964
	DWG CHG LTR	DNA
Y-20161R	CONTRACT NO.	
	GEN ORDER NO.	5252
SCD52-52701-275	SPEC NO.	
DNA	SERIAL NO.	4053579
52-52701-275	PART NO.	207510-21

SE-7 DELIVERABLE END ITEM – LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

1.

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DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE QUALITY CONTROL.

	52-52701-275 PART NO. 207510-21	
FOREWORD--SE-7 LOG BOOK	PART NAME THRUST CHAMBER, 85 LB., ASSY OF	2.0

R-15019-2

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2.0	FOREWORD
3.0	CONTENTS
4.0	MODULE/COMPONENT ASSEMBLY LOG--SECTION I
4.1	CONFIGURATION & SERIALIZATION LOG
4.2	MCR VERIFICATION
4.3	VARIATION LOG
4.4	REPLACEMENT LOG
5.0	COMPONENT ACCEPTANCE TEST LOG--SECTION II
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5.1.2	COMPONENT ACCEPTANCE TEST
5.1.3	COMPONENT ACCEPTANCE TEST
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5.2	CALIBRATED PERFORMANCE DATA
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5.3	INFORMATION--CONTAMINATION

52-52701-275 PART NO. 207510-21

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PART NAME THRUST CHAMBER, 85 LB., ASSY OF

3.0

SECTION I

	52-52701-275 PART NO. 207510-21
SE-7 MODULE / COMPONENT ASSEMBLY LOG	PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.0

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	207510-21	DNA	THRUST CHAMBER, 85 LB., ASSY OF	4053579	4 Q 63	
2	207511-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4049155	4 Q 63	
2	207518	DNA	SHELL, THRUST CHAMBER, ASSY OF	8500954		
3	207525	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7021110		
2	407561	DNA	VALVE, OXIDIZER, T/C, ASSY OF	8722099		
2	407662	DNA	VALVE, FUEL, T/C, ASSY OF	9183335		

R-15019-2

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DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

SE-7 CONFIGURATION & SERIALIZATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

4.1

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	10 JUNE 64	ANR 721
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	10 JUNE 64	ANR 721
SE6-085	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	10 JUNE 64	ANR 721
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	10 JUNE 64	ANR 721
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	10 JUNE 64	ANR 721
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	10 JUNE 64	ANR 721
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	10 JUNE 64	ANR 721
SE6-179	13 MAR 64	TUBE STUBS; MARKING OF	10 JUNE 64	ANR 721
SE7-041	15 APR 64	85# AND 100# THRUST CHAMBER ASSEMBLIES, PROPELLANT VALVES, INLET TUBES MATERIAL; CHANGE TO 304L BAR PER QQ-S-763	10 JUNE 64	ANR 721
SE7-085	30 APR 64	85 & 100 LB., TCA DIMENSIONS; CHANGES TO	10 JUNE 64	ANR 721

DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM - MCR VERIFICATION

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP
MAC MRR #55355	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: CONDITION A: 5.20 ± .030 C/L of 10-32 THD. HOLE ON BOSS TO TOP OF INLET TUBE, FUEL SIDE, IS 5.167 (U/TOL .003). CONDITION B: 5.20 ± .030 C/L OF 10-32 THD. HOLE ON BOSS TO TOP OF INLET TUBE, OXIDIZER SIDE IS 5.154 (U/TOL .016). REF. 23H R19947 DISPOSITION: ACCEPTABLE TO USE PER MAC MRR #55355	ANR 645
MAC MRR #59920	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: CONDITION A: ASSEMBLY CONTAINS (1) ONE CRACK IN THE THROAT INSERT (AFTER HOT FIRE) DIMENSIONED AS FOLLOWS: POSITION OF CRACK (ROTATED CLOCKWISE, LOOKING INTO NOZZLE END) IS 191° FROM THE SLOTTED TANG ON OUTER SHELL; DIRECTION OF CRACK IN RELATION TO THRUST AXIS IS 11°. CRACK WIDTH AT MEASURED SURFACE IS .0007 TO .0015 WIDE. REF. 23H R19865 DISPOSITION: ACCEPTABLE TO USE PER MAC MRR #59920	ANR 645
MAC MRR #59972	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: CONDITION A: UPON INSPECTION AFTER 3 SEC. OF SUCCESSFUL HOT-FIRE IT WAS EVIDENT THAT THE #207515 THROAT INSERT WAS LOOSENED FROM T.C. SEGMENT AND HAS A VERTICAL MOVEMENT OF .030. DISPOSITION: ACCEPTABLE TO USE AS IS. MARK IN RED, ACCEPTABLE FOR S/C #3A ONLY, PER MAC MRR #59972.	ANR 645

DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

4.3

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
MAC MRR #59972 N.O.R. #1	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: CONDITION A: REASON FOR NOTICE OF REVISION #1: CHANGE SERIAL NUMBER "NA830107" ON ORIGINAL MRR NO. 59972, TO "4053579". DISPOSITION: ACCEPTABLE TO USE. PER MAC MRR 59972, N.O.R. #1	
MAC MRR #59920 N.O.R. #1	THRUST CHAMBER 85 LB., ASSY OF	207510-21	4053579	DISCREPANCY: CONDITION A: THIS NOR #1 CHANGES 207510-61 TO 207510-21. CONDITION B: CHANGE DISPOSTION "ACCEPTABLE TO USE" TO "USE FOR D.A.T. DISPOSITION: ACCEPTABLE TO USE FOR DAT PER MAC MRR #59920 N.O.R. #1	
MAC MRR #55355 N.O.R. #1	THRUST CHAMBER 85 LB., ASSY OF	207510-21	4053579	DISCREPANCY: CONDITION A: THIS NOR #1 CHANGES 207510-61 TO 207510-21. CONDITION B: CHANGE DISPOSITION ACCEPTABLE TO USE - TO USE FOR D.A.T. DISPOSITION: ACCEPTABLE TO USE FOR DAT. PER MAC MRR #55355 N.O.R. #1	

DNA SERIAL NO. 4053579
52-52701-275 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

4.3

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
23H #R14251	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: P/N NA5-28139T1 FILTER ASSY. ON FUEL VALVE ASSY. IS DISTORTED FROM .450 TO .435 ON FILTER FLANGE. 23H #R14251 REPLACES 23H #R14373. DISPOSITION: USE AS IS PER 23H #R14251.	
23H #R14251 N.O.R. #1	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: REASON FOR NOTICE OF REVISION #1 TO CHANGE 207510-51 TO 207510-61. DISPOSITION: NOTICE OF REVISION #1 TO CHANGE 207510-51 TO 207510-61.	
23H #R14251 N.O.R. #2	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: REASON FOR NOTICE OF REVISION #2 SERIAL NO. OF THIS ENGINE ON 23H #R14251 AND N.O.R. #1 IS 4053603. S/B 4053579. DISPOSITION: NOTICE OF REVISION #2 CHANGE S/N FROM: 4053603 TO: 4053579	
23H #R14252	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: 207510-51, S/N NA830107 T.C.A. 85# DURING RUN #A230 OSILLOGRAPH TRACES ON PROP VALVES INDICATED AN OPENING TIME OF APPROX. .024 SEC ON FUEL VALVE & .027 ON OXID VALVE. MAX. ALLOWABLE IS .021 SEC PER RA0220-269 PARA 4.6.8. REF. OFR #1637R DISPOSITION: USE AS IS PER 23H #R14252	

DNA 52-52701-275 SERIAL NO. 4053579 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 4.3

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
23H #R14252 N.O.R. #1	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: REASON FOR NOTICE OF REVISION #1 TO CHANGE 207510-51 TO 207510-61 DISPOSITION: NOTICE OF REVISION #1 CHANGE 207510-51 TO 207510-61.	
23H #R14252 N.O.R. #2	THRUST CHAMBER 85 LB., ASSY OF	207510-61	4053579	DISCREPANCY: REASON FOR NOTICE OF REVISION #2 SERIAL NO. OF THIS ENGINE ON 23H R14252 AND N.O.R. #1 IS 4053603. S/B 4053579. DISPOSITION: NOTICE OF REVISION #2 CHANGE S/N FROM: 4053603 TO: 4053579	

DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

SE-7 DELIVERABLE END ITEM — VARIATION LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
R-15019-2			NONE THIS DATE (10 JUNE 64)			ARR 645

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DNA 52-52701-275	SERIAL NO.	4053679
	PART NO.	207510-21
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG	PART NAME THRUST CHAMBER, 85 LB., ASSY OF	4.4

SECTION II

52-52701-275 PART NO. 207510-21

SE-7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES	4.2				
BODY TEMPERATURE					
OXIDIZER	4.2.4	DEGREES F	70 ± 5	72	ANR 142
FUEL	4.2.11	DEGREES F	70 ± 5	72	ANR 142
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	41.672	ANR 142
FUEL	4.2.11	OHMS	42 ± 2	41.072	ANR 142
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.068	ANR 142
FUEL	4.2.11	OHMS	1.0 MAX.	.061	ANR 142
DIELECTRIC STRENGTH TEST--TCA PROPELLANT VALVES	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	57	ANR 142
FUEL	4.3.11	MICROAMPS	500 MAX.	49	ANR 142
PROOF PRESSURE TEST--TCA PROPELLANT VALVES	4.4				
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER					
STEP I	4.4.3	PSIG	500	VERIFIED	ANR 142
STEP II	4.4.5	PSIG	500	VERIFIED	ANR 142

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	N/C	NONE	DNA 52-52701-275	SERIAL NO. 4053579 PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)	4.4				
FUEL					
STEP I	4.4.7	PSIG	500	VERIFIED	AMR 142
STEP II	4.4.7	PSIG	500	VERIFIED	AMR 142
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	VERIFIED	AMR 142
STEP II	4.4.5	DNA	NONE ALLOWED	VERIFIED	AMR 142
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	VERIFIED	AMR 142
STEP II	4.4.7	DNA	NONE ALLOWED	VERIFIED	AMR 142

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	N/C	NONE	DNA SERIAL NO. 4053579	
			52-52701-275 PART NO. 207510-21	
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
D-15019-2					
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT					
STEP I	4.5.8	PSIG	480 ± 10	VERIFIED	
STEP II	4.5.10	PSIG	480 ± 10	VERIFIED	
LEAKAGE TEST					
STEP I	4.5.8	DNA	NONE ALLOWED	VERIFIED	
STEP II	4.5.10	DNA	NONE ALLOWED	VERIFIED	
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	NONE ALLOWED	VERIFIED	
FUNCTIONAL TEST--TCA PROPELLANT VALVES	4.6				
OPENING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.021 MAX.	.020	
FUEL	4.6.8	SEC.	0.021 MAX.	.018	
CLOSING RESPONSE TIME					
OXIDIZER	4.6.17	SEC.	0.005 MAX.	.0036	
FUEL	4.6.10	SEC.	0.005 MAX.	.0032	
CLOSING DROP OUT VOLTAGE					
OXIDIZER	4.6.17	VOLT (DC)	1 MIN.	1.5	
FUEL	4.6.13	VOLT (DC)	1 MIN.	1.8	

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SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	N/C	NONE	DNA 52-52701-275	SERIAL NO. 4053579 PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAKAGE TEST -TCA PROPELLANT VALVES	4.7				
SEAT LEAKAGE RATE					
OXIDIZER	4.7.17	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 142
FUEL	4.7.22	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 142
PRE-TEST DATA					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.1.3	LB.	DNA	8.48	ANR 142
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.270	ANR 142
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.6732	ANR 142
B-B		INCH	DNA	.6732	ANR 142
C-C		INCH	DNA	.6732	ANR 142
D-D		INCH	DNA	.6732	ANR 142
POST HOT-FIRE DATA					
PROOF PRESSURE TEST					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.14.1	LB.	DNA	8.49	ANR 142
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					

R-15019-2

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	N/C	NONE	DNA	SERIAL NO. 4053579
			52-52701-275	PART NO. 207510-21
SE-7 COMPONENT ACCEPTANCE TEST			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.1.3

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
* POST HOT-FIRE DATA (CONTINUED)					
PROOF PRESSURE TEST					
STEP I	4.14.5	PSIG	480 ± 10	VERIFIED	ANR 645
STEP II	4.14.5	PSIG	480 ± 10	VERIFIED	ANR 645
* LEAKAGE TEST THRUST CHAMBER					
STEP I	4.14.5	DNA	NONE ALLOWED	VERIFIED	ANR 645
STEP II	4.14.5	DNA	NONE ALLOWED	VERIFIED	ANR 645
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.14.5	DNA	NONE ALLOWED	VERIFIED	ANR 645
** LEAKAGE TEST--TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.14.5	SCC/MIN	2.23 MAX.	1.10	ANR 645
FUEL	4.14.5	SCC/MIN	2.23 MAX.	LESS THAN 0.1	ANR 645
** LEAK TEST--WELDED JOINTS					
LEAK TEST					
PRESSURIZED INLET TUBE WITH GASEOUS HELIUM					
OXIDIZER	4.14.6	PSIG	500 ± 10	VERIFIED	ANR 645
FUEL	4.14.9	PSIG	500 ± 10	VERIFIED	ANR 645

SPECIFICATION NUMBER	REVISION	AMENDMENT
* RA0220-348	N/C	NONE
** RA0220-348	A	NONE

DNA 52-52701-275 SERIAL NO. 4053579 PART NO. 207510-21

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 5.1.4

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
LEAK TEST--WELDED JOINTS (CONTINUED)					
** JOINT LEAKAGE RATE					
OXIDIZER	4.14.7	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	
FUEL	4.14.9	SCC/SEC	10^{-6} MAX.	LESS THAN 10^{-6}	
* INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.14.10	DNA	NONE ALLOWED	VERIFIED	
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	4.140	
THROAT DIAMETER (DELIVERED CONDITION)	4.15.1				
SECTION A-A		INCH	DNA	.6732	
B-B		INCH	DNA	.6732	
C-C		INCH	DNA	.6732	
D-D		INCH	DNA	.6732	
DRY WEIGHT (DELIVERABLE CONDITION) (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.15.2	LB.	DNA	8.31	
INSPECTED VISUALLY FOR CLEANLINESS, CORROSION, DETERIORATION, DAMAGE OR DEFORMATION	4.15.3	DNA	NONE ALLOWED	VERIFIED	

R-15019-2

SPECIFICATION NUMBER	REVISION	AMENDMENT
** RA0220-348	A	NONE
* RA0220-348	N/C	NONE

SE- 7 COMPONENT ACCEPTANCE TEST

DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

PART NAME THRUST CHAMBER, 85 LB., ASSY OF 5.1.5

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R-11501-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 230 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NTF	ANR 721
CELL LOCATION	-	-	-	-	-	1-A	ANR 721
CELL NUMBER	-	-	-	-	-	379	ANR 721
TEST DATE	-	-	-	-	-	28 DEC 63	ANR 721
TEST DURATION	SEC.	3 MIN.	-	-	-	3.0	ANR 721
ENVIRONMENTAL Pc	PSIA	0.16 MAX	-	-	-	.064	ANR 721
AMBIENT PRESSURE	PSIA	DNA	-	-	-	12.187	ANR 721
AMBIENT TEMPERATURE	^{o}F	DNA	-	-	-	53.8	ANR 721
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.8	ANR 721
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	ANR 721
OXIDIZER TEMPERATURE	^{o}F	DNA	-	-	-	49.8	ANR 721
FUEL TEMPERATURE	^{o}F	DNA	-	-	-	45.8	ANR 721
OXIDIZER DENSITY	LB/FT^3	DNA	-	-	-	92.090	ANR 721
FUEL DENSITY	LB/FT^3	DNA	-	-	-	55.444	ANR 721

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SPECIFICATION NUMBER RA0220-348 | REVISION N/C | AMENDMENT NONE

DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

SE- 7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

5.2

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 230 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NTF	ANR 721
OXIDIZER INLET PRESSURE	PSIA	285 ± 10	-	-	-	287.547	ANR 721
FUEL INLET PRESSURE	PSIA	287 ± 10	-	-	-	291.486	ANR 721
OXIDIZER FLOWRATE	LB/SEC	DNA	-	-	-	.170	ANR 721
FUEL FLOWRATE	LB/SEC	DNA	-	-	-	.106	ANR 721
THRUST	LB.	DNA	-	-	-	81.07	ANR 721
MIXTURE RATIO	O/F	DNA	-	-	-	1.607	ANR 721
SPECIFIC IMPULSE	SEC	DNA	-	-	-	295.	ANR 721
INJECTOR END Pc	PSIA	DNA	-	-	-	127.347	ANR 721
CHARACTERISTIC VELOCITY	FT/SEC	DNA	-	-	-	5296.550	ANR 721
THROAT DIAMETER	INCH	DNA	-	-	-	.673	ANR 721
FUEL ORIFICE DIAMETER	INCH	DNA	-	-	-	.065	ANR 721
OXIDIZER ORIFICE DIAMETER	INCH	DNA	-	-	-	.078	ANR 721
TCA FIRING TIME (TOTAL)	SEC	10 MAX.	-	-	-	3.0	ANR 721
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	119	ANR 721
FUEL SAMPLE NUMBER	-	-	-	-	-	118	ANR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT		
RA0220-348	N/C	NONE	DNA 52-52701-275	SERIAL NO. 4053579 PART NO. 207510-21
SE- 7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 85 LB., ASSY OF	5.2.1

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R-15019-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 230 FINAL TEST DATA	INSI
HOT FIRE TEST DATA--TEST SITE	-	-	-	-	-	NTF	ANR 721
ADJUST TO STANDARD CONDITIONS							
THRUST	LB.	79 ± 3.9	-	-	-	80.84	ANR 721
MIXTURE RATIO	O/F	1.60 ± .05	-	-	-	1.609	ANR 721
SPECIFIC IMPULSE	SEC	DNA	-	-	-	298.	ANR 721
INJECTOR END Pc	PSIA	DNA	-	-	-	125.516	ANR 721
CHARACTERISTIC VELOCITY	FT/SEC	DNA	-	-	-	5296.876	ANR 721
ADJUST TO RATED CONDITIONS							
THRUST	LB.	79	-	-	-	79.00	ANR 721
MIXTURE RATIO	O/F	1.6	-	-	-	1.600	ANR 721
SPECIFIC IMPULSE	SEC	280 MIN.	-	-	-	298.	ANR 721

SPECIFICATION NUMBER	REVISION	AMENDMENT
RA0220-348	N/C	NONE
RA0220-231	N/C	#1

DNA SERIAL NO. 4053579

52-52701-275 PART NO. 207510-21

SE-7 (REA) CALIBRATED PERFORMANCE DATA

PART NAME THRUST CHAMBER, 85 LB., ASSY OF

5.2.

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THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

		LIMITS	ACTUAL COUNT MMH - FUEL	ACTUAL COUNT NTO - OXID
	10 - 25	500	152	156
	25 - 50	100	54	46
	50 - 100	18	17	14
	100 - 300	6	8	5
	300 - 1000	1	0	0
	> 1000	0	0	0
FIBERS	300 - 3000	4	1	0
FIBERS	> 3000	0	0	0

CLASS 7

INSP. ANR 645

SPECIFICATION NUMBER	REVISION	AMENDMENT	
RA0615-003	B	NONE	52-52701-275 PART NO. 207510-21
SE- 7 INFORMATION--CONTAMINATION			PART NAME THRUST CHAMBER, 85 LB., ASSY OF 5.3

APPENDIX D

DESIGN APPROVAL TEST SPECIFICATION AND DATA

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DESIGN APPROVAL TEST OF COMPONENTS

FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

(SE-7)

THRUST CHAMBER ASSEMBLY - 85#

McDonnell Part Number - 52-52701-275
Rocketdyne Part Number - 207510-21
Test Number - 207510-401

This drawing is (PRELIMINARY / FINAL) approval (with / without) changes. Such approval does not relieve Seller warranty as provided in M A C purchase order conditions

EFF: | CONT. DWG. 52-52701 | 14 Aug 64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.
6633 CANOGA AVENUE
CANOGA PARK, CALIFORNIA

PREPARED BY

E. Adams

APPROVED BY

R. W. Helsel
Sr. Project Engineer
Gemini

NO. OF PAGES 171

REVISIONS

DATE 12 August 1964

DATE	REV. BY	PAGES AFFECTED	REMARKS
8-31-64	E.A.	50 & 163	Deleted Vib. Accel
9-1-64	E.A.	167	Revised Figure 11
9-1-64	E.A.	168	Revised Figure 11B
9-17-64	J.G	36,37 &38	Revised Procedure
10-3-64	E.A	30	Changed Figure 12 to 10
10-6-64	E.A	168.1	Added Figure 11A
10-6-64	E.A	90 &109	Added Paragraph
9-26-64	R.C	49 &50	Revised Procedure

-15019-2

DATE	REV.BY	PAGES AFFECTED	REMARKS	
9-9-64	E.A	55	Changed X to Z	A
9-28-64	J.G	153 & 154	Revised Table I	A
9-28-64	J.G	154.1	Added Page	A
9-28-64	J.G	162	Revised Figure 6	A
10-12-64	E.A	41.2	Added Sentence	A
10-15-64	E.A	96	Revised Paragraph	A
10-9-64	J.G	153,154 &154.1	Revised Table I	B
[illegible]-9-64	J.G	162	Revised Figure 6	B
10-9-64	J.G	153 & 154	Revised Table I	C
10-19-64	J.G	162	Revised Figure 6	C
10-21-64	J.G	39,40 &41	Revised Procedure	C
10-21-64	J.G	41.1	Added Page	C
11-18-64	R.C	86,105 &151	Revised Procedure	C
11-18-64	R.C	86.1, 87.1,	Added Pages	C
11-18-64	R.C	105.1, 106.1	Added Pages	C
11-18-64	R.C	151.1 & 152.1	Added Pages	C
11-23-64	J.G	154	Revised Table I	D

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THRUST CHAMBER ASSEMBLY - 85#

McDonnell Part Number 52-52701-275

Rocketdyne Part Number 207510-21

Test Number 207510-401

DESCRIPTION OF COMPONENT

The Orbit Attitude and Manuever System consists of an ablation cooled thrust chamber and expansion nozzle segments, an injector, two fast acting solenoid valves for propellant flow control, orifices for fixing the component pressure drop, associated interconnecting plumbing and mounting provisions for attaching the assembly to the spacecraft structure.

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5.		Graph - Propellant Valve Voltage and Current Traces
6.		Schematic - TCA Hot Fire Propellant Feed System
7.		Drawing - Vibration and Shock
8.		Graph - Random Vibration
9.		Schematic - Propellant Valve Service Life
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11.		Drawing - Propellant Valve Inlet Adapter
12.		Trace - Thrust Pulse Parameters
13.		Schematic - Thrust Vector
14.		Schematic - Sectioning Diagram

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 85# — PART NO. {MAC 52-52701-275 / NAA 207510-21}

TEST NO. 207510-401

Reference: MAC SCD 52-52701, Rev. F

1.0 SCOPE

This specification establishes the method of test and the test equipment required to conduct the Design Approval Tests of three Thrust Chamber Assemblies for the McDonnell Aircraft Corporation Model 133P Orbit Attitude and Manuever System as specified in McDonnell Aircraft Corporation Specification Control Drawing 52-52701, Revision F, paragraph 6.3.1.3.2.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

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Reference:(a) MAC SCD 52-52701 Revision F

2.0 APPLICABLE DOCUMENTS

The documents listed in this specification are for reference only except those marked with an asterisk (*). If the requirements of this specification differ from those listed below, the requirements of this specification shall govern, except in the case of SCD 52-52701 which is the contractual controlling document.

2.1 McDonnell Aircraft Specifications

SCD 52-52701	Specification Control Drawing, MAC Model 133P, Orbit Attitude and Manuever System Rev. F, dated 9 August 1963.(CONFIDENTIAL)
*Report #8392	Standard Engineering Responsibilities Technical Data Requirements and Product Support Recommendations, Model 133P SCD Equipment, dated 8 October 1962.
Report #8518	General Electrical Design Requirements for Electrical Equipment and Equipment Utilizing Electrical Power for MAC Model 133P, dated 1 May 1962.

2.2 McDonnell Drawings

Drawing 506612-5-5	Elbow
Drawing 506737-5-5	Union

2.3 MILITARY SPECIFICATIONS

MIL-E-5272C-1	Environmental Testing, Aero and associated equipment, general specification for, dated 20 January 1960

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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2.3 (cont'd)	MIL-L-25567	Leak Test Compound, Oxygen System, dated 7 January 1959.
	MIL-P-26539A	Propellant, Nitrogen Tetroxide, dated 31 July 1961.
	MIL-P-27401A	Propellant, Nitrogen Pressurizing, dated 7 November 1960.
	MIL-P-27404	Propellant, Monomethyl Hydrazine, dated 3 April 1962.
	MIL-A-6091B	Alcohol; Ethyl specially denatured, dated 12 January 1962.
	Federal Stock No. 6830-263-9842	Helium
2.4	Rocketdyne Specifications	
	RA0107-003	Fusion Welding of Rocketdyne Components, dated 18 October 1961.
	*RA0112-002	Lubricants Anti-Seize Compounds and Gasketing Type Seal Compounds for Rocket Engines, dated 29 July 1963.
	* RA0220-231	SE-7 207510 Thrust Chamber Assembly Data Reduction, dated 15 July 1963.
	*RA0220-290	SE6 and SE7 Propulsion System Component Weight Determination, dated 2 October 1963.
	*RA0220-348	SE7 Thrust Chamber Assembly Acceptance Test Procedure (207510), dated 1 January 1964.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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2.4 (cont'd)	*RA0201-050	Acceptance Test Instrumentation Requirements, dated 9 August 1961
	*RA0607-009	In Place Brazing of Tubes and Fittings for Space Engines, dated 30 December 1963
	*RA0610-002	Ultrasonic Cleaning of Space Engine Hardware, dated 20 June 1963
	*RA0610-003	Cleaning Space Engine Hardware by liquid flushing, dated 24 October 1963
	*RA0610-009	Chemical Cleaning of Filter Elements for Space Engines
	*RA0616-005	SE7 Propulsion System Inter and Intra Plant Handling, dated 20 March 1963
	*RA0616-008	SE7 Propulsion System: Preparation for Customer Delivery, Dated 4 September 1963
	SEM 4388-4040	Pulse Performance Data Reduction Procedure, dated 22 July 1964
	*SEM 4388-4041	Thrust Vector Performance Date Reduction Procedure
	*PEM 25.01G	Environmentally Controlled Areas definition and specifications for, dated 2 December 1963
2.5	Rocketdyne Drawings	
	Drawing 207510-21	Thrust Chamber, 85 lbs, 4.5 Min., Assy of, dated 9 July 1963

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

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2.5 (cont'd) Rocketdyne Drawings

Drawing T5030469	Pressure Test and Water Flow Fixture, dated 10 December 1962
Drawing 99-106126	Adapter, Fitting, Assy. of, dated 22 October 1963
Drawing 99-106417	Propellant Outlet Adapter, dated 30 January 1964
Drawing 9017844	Seal Assembly, Thrust Chamber Drain, 100 LB. TCA, dated 11 September 1962
Drawing SK 9999	Assembly and Installation Thrust Vector Angularity Measuring System, 85 and 100 LB., SE7 Space Engines, dated
Drawing 99-1066	Tube - Assy. of, (Fuel), dated
Drawing 99-106689	Tube - Assy. of, (Oxidizer), dated
Drawing 99-106700	85# TCA Installation (DAT), dated
Drawing	Shipping Container, SE7 TCA (85#) with Extended Inlet Adapters, dated
Drawing 99-106726	Propellant Valve Orifice Adapter, (85&100) A dated 22 September 1964
Drawing 99-106727	Propellant Valve Orifice Adapter, (85 & 100) A dated 23 September 1964

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REVISION A J. D. Mangeron Dated 9-17-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

TEST NO. 207510-401 SHEET 6 OF 17

Reference: (a) MAC SCD 52-52701, Revision F

3.0 GENERAL REQUIREMENTS

3.1 Safety

All safety precautions necessary to comply with this procedure shall be in accordance with Rocketdyne Safety Department Directives.

3.2 Handling

All inter and intra plant handling and packaging shall be accomplished per the requirements of Rocketdyne Specification RA0616-005 when the TCA is being transported or stored between tests, except that components with extended inlet tubes installed shall be packaged in Container RK . Adequate measures shall be taken to prevent accidental damage to the TCA at all times.

3.3 Photographic Coverage

Photographs shall be taken of each different test setup and shall be included in the final test report. Three preliminary copies of these pictures shall be forwarded to the Rocketdyne Gemini Project Office within 14 days from the exposure date.

Photographs shall be taken of each different test setup and shall be taken of the component after any malfunction. Sufficient views shall be taken to provide complete visual coverage of the failure, including photomicrographs when applicable.

3.4 Instrumentation (paragraph 6.2.1.2 of reference a)

All test parameters shall be assigned a tolerance of ±2% of the specified value unless otherwise specified herein.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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.4 (cont'd) All instrumentation employed for monitoring the required test parameters shall be calibrated to insure attainment of minimum steady-state accuracy of ±2% of the full scale range of the instrumentation being employed except were instrumentation accuracy is otherwise specified.

Calibration records shall be maintained and made available to authorized personnel upon request. Hot fire instrumentation shall be in accordance with specification RA0201-050 and Table 1 of this specification.

.5 Maintenance (paragraph 6.2.3 of reference a)

Servicing, adjustment, or replacement of parts shall not be permitted unless specifically stated in this specification. Lubrication of fittings is permitted per RA0112-002.

.6 Failures (paragraph 2.5.2 of McDonnell Report 8392)

In the event that the component fails to pass any part of the Design Approval Test, immediately discontinue all testing of that component and notify the Rocketdyne Gemini Project Office.

McDonnell Aircraft Corporation and Rocketdyne shall jointly review the failure and determine the corrective action to be taken and the point in the test procedure where retesting is to begin.

.7 Test Witnessing (paragraph 6.2.1.3 of reference a)

Each Design Approval Test shall be witnessed and the test data certified by Rocketdyne inspection, and certified by the Government Inspection Agency having cognizance at the testing facility. McDonnell and Government inspectors shall be notified 4 hours in advance of all tests.

PREPARED BY: E. Adams DATE 6-25-64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL DATE
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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3.7 MAC Engineering shall be notified 3 days in advance of the schedule date of any Design Approval Test. If MAC Engineering indicates a desire to witness any test, notification shall again be performed 4 hours prior to the beginning of the test. Actual testing shall not commence prior to the arrival of all witnesses unless prior waiver is obtained. Notification of the MAC Resident Engineering Office shall constitute notification of MAC Engineering.

3.8 Cleanliness Requirements

Hot Fire Test and Decontamination Facilities: During the time that the TCA is being installed in or removed from a hot fire test facility or a decontamination facility, the TCA propellant valve inlets, when open, shall be protected by a plastic enclosure. A low volume nitrogen purge, filtered through two, 10 micron absolute, stainless steel wire mesh filters, installed in series, shall be used to prevent entrance of foreign material into the enclosure.

Other Test Facilities: The propellant valve inlets shall not be directly exposed to an environmental atmosphere which does not meet the requirements of a Class IV area as specified in Rocketdyne Plant Engineering Manual PEM 25.01G. It shall be a requirement that a ten (10) micron absolute wire mesh stainless steel filter be installed on the propellant valve inlets in a Class IV area. The entire test setup shall be assembled and disassembled in a Class IV area.

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3.8 (cont'd) Cleaning of Test Setup Hardware:

The ten micron absolute stainless steel wire mesh filters shall be cleaned per Rocketdyne Specification RA0610-009 and stored in polyethylene bags until ready for use. Millipore filter housings shall be cleaned per Rocketdyne Specification RA0610-003 prior to installation of the new Millipore filter elements into the housings. The Millipore filter assemblies shall be stored in polyethylene bags until ready for use. The lines which are to be used between the test setup filters and the TCA shall be cleaned per Rocketdyne Specification RA0610-002 each time the filters are installed into test setup. Test setup hardware, which is too large for polyethylene bags, shall be protected by appropriate closures, which have also been cleaned so as not to lower the level of cleanliness of the hardware.

3.9 Report

Data

Data shall be recorded directly on the applicable data sheets inserted after each test of this specification. All raw data shall be identified relative to the test to which it pertains. That raw data specifically requested by MAC Engineering shall be further identified relative to parameter measured, calibration factors, etc. and shipped to MAC, St. Louis. Reduced data shall include graphical presentations and time histories of all pertinent performance parameters.

Discussion of Data

In the final report all pertinent data obtained in the DAT series shall be analyzed and discussed. Any significant trends leading to pertinent conclusions or recommendation for further testing shall be covered.

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3.9 (cont'd) Acceptance Test Data

Acceptance test data shall be retained and be included as part of the final report for this component.

3.10 Component Test Modification

The propellant valve inlets of each TCA shall be modified following Pre-Test Inspection by the addition of an inlet tube adapter, see figure 11. Attachment of the adapter shall be by brazing in accordance with RA0607-009. Failure at the inlet adapter or the braze joint during subsequent testing shall not constitute a failure of the TCA.

3.11 Sampling and Analysis of Propellants

Samples of propellants shall be obtained for analysis whenever propellants are introduced into the test facility tanks and at least once daily, during the time that DAT hot fire tests are conducted, for the purpose of specific gravity determination.

Samples of propellants shall be obtained for analysis whenever propellants are introduced into the test facility tanks and at least once weekly, during the time that DAT hot fire tests are conducted, for the purpose of propellant composition determination.

The date of the most recent analysis shall be recorded for each hot fire test. However, in the event that propellant tanks are filled between DAT hot fire test subsequent hot fire testing shall be delayed pending the results of the analysis of the new propellant.

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3.12 Post Test Hardware Disposition

Upon successful completion of all Design Approval Test, the components shall be cleaned as required for shipment, packaged in accordance with RA0616-008, and shipped directly to MAC, St. Louis. This shall not include components which fail during DAT and for which a failure analysis is required, except that components showing unusual failure modes shall be made available to MAC following Rocketdyne failure analysis.

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3.13 Abbreviations

Abs	-	Absolute
AC	-	Alternating Current
cps	-	Cycles per Second
DAT	-	Design Approval Test
DC	-	Direct Current
F	-	Fahrenheit
Freq	-	Frequency
g	-	Acceleration of Gravity
GN_2	-	Gaseous Nitrogen
He	-	Helium
Hr	-	Hour
MAC	-	McDonnell Aircraft Corporation
Min	-	Minimum
NOM	-	Nominal
OAMS	-	Orbit Attitude and Manuever System
Prop	-	Propellant
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
RMS	-	Root - Mean - Square
SCC	-	Standard Cubic Centimeters
SCD	-	Specification Control Drawing
Sec	-	Seconds
TCA	-	Thrust Chamber Assembly
V	-	Volts or Valve
P_m	-	Maximum Pressure

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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3.14 Definitions

*Duration- Total time from "first indication" in starting sequence to 2%-of-maximum thrust point in the shutdown sequence.

Impulse, Mean Specific - Total impulse divided by total weight of propellants consumed.

Impulse, Specific - The thrust in pounds divided by the propellant consumption rate in pounds per second.

Impulse, Total - Area under the thrust-time curve.

*Pulse - A pulse includes all events from the "on signal" to 2-percent-of-maximum thrust point in the shutdown sequence.

*Signal, ON - The signal to open the propellant valves. This is the start of the starting sequence.

*Signal, OFF - The signal to close the propellant valves. This is the start of the shutdown sequence.

*Signal Width - Time from "on signal" to "off signal" .

*Time, Start - Time from "on signal" to the 90 percent-of-maximum thrust point in the starting sequence.

*Time, Shutdown - Time from "off signal" to 2-percent-of-maximum thrust point in the shutdown sequence.

*Time, Effective Firing - Time from 90-percent-of-maximum thrust point in the start sequence to the 90-percent-of-maximum thrust point in the shutdown sequence.

Lockup Pressure - Pressure immediately upstream of the propellant valve prior to TCA operation.

* See Figure 12

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3.14 (cont'd) Soakout Period - Time required for slowest TCA skin temperature to stabilize and drop 5°F to verify that peak temperature has been reached. A

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Rev. A J.D. Marriage dated 10-15-64

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Reference: MAC SCD 52-52701, Revision F, Figure 12

4.0 Test Program

Three Thrust Chamber Assemblies (P/N 207510-21), having passed the acceptance tests of RA0220-348 shall be subjected to Design Approval Tests in accordance with the requirements herein specified. For purposes of identification during the DAT program, the three TCA's shall be designated "one" through "three", respectively.

4.1 Test Sequence

The following paragraphs list each TCA, the applicable environmental and service life tests for that TCA and the operational tests and procedures which will be used to demonstrate SCD compliance. The tests for each TCA shall be performed in the order listed.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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4.1.1 Thrust Chamber Assembly Number One

	Para.	Page	SCD Reference
Pre-Test Inspection	7.1.1		6.2.2.1
Weight Determination	6.6		6.3.1.4.1
Vibration	7.1.2		6.2.3.17.3
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
Visual Inspection	6.5		6.2.2.1
Mechanical Shock	7.1.3		6.2.3.16
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
Visual Inspection			6.2.2.1
Temperature Shock	7.1.4		6.2.3.7
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
DAT Duty Cycle to Failure	7.1.5		6.3.1.3.2.2
Disassembly and Inspection	7.1.6		6.2.3.20.1

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4.1.6 Thrust Chamber Assembly Number Two

	Para.	SCD Page Reference
Pre-Test Inspection	7.2.1	6.2.2.1
Weight Determination	6.6	6.3.1.4.1
Thrust Vector	7.2.2	6.3.1.3.2.2
DAT Duty Cycle to 147 Seconds	7.2.3	6.3.1.3.2.2
Burst Pressure	7.2.4	6.3.1.3.2.2
Weight Determination	6.6	6.3.1.4.1
Disassembly and Inspection	7.2.5	6.2.3.20.1

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4.1.5 Thrust Chamber Assembly Number Three	Para.	Page	SCD Reference
Pre-Test Inspection	7.3.1		6.2.2.3
Weight Determination	6.6		6.3.1.4.1
Thrust Vector	7.3.2		6.3.1.3.2.2
DAT Duty Cycle to 270 Seconds	7.3.3		6.3.1.3.2.2
Weight Determination	6.6		6.3.1.4.1
Propellant Valve Service Life	7.3.4		6.3.1.3.2.2
Propellant Valve Proof Pressure & Leakage	6.1		6.2.3.1
Propellant Valve Electrical Resistance	6.3		6.2.3.2
Propellant Valve Dielectric Strength	6.4		6.2.3.3
Propellant Valve Functional	6.5		6.3.1.3.1
Disassembly and Inspection	7.3.5		6.2.3.20.1

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Reference: MAC SCD 52-52701, Revision F

5.0 EQUIPMENT AND MATERIAL (Equivalent items may be used)

5.1 Material

5.1.1 Nitrogen Tetroxide - MIL-P-26529A (Oxidizer) (0.3% Water Permitted)

5.1.2 Monomethyl Hydrazine - MIL-P-27404A (Fuel)

5.1.3 Nitrogen Gas - MIL-P-27401A

5.1.4 Freon TF - Commercial Grade

5.1.5 Water - Distilled and/or De-ironized (pH: 6.5 to 7.5)

5.1.6 Helium - Federal Stock Number 6830-263-9842

5.1.7 Alcohol - MIL-A-6091B (Reagent Grade Isopropl Alcohol Am. Chem. Soc. Standard is considered equivalent)

5.1.8 Leak Test Compound - MIL-L-25567

5.2 Special Equipment

5.2.1 Hot Fire Facility

A facility capable of static firing the TCA's at both ambient conditions and at a simulated pressure altitude of 100,000 feet or greater.

Suitable equipment to provide and utilize hot GN_2 purge, Anhydrous Isopropl Alcohol and Freon TF fluids for decontamination, flushing and cleaning the TCA after firing.

The facility shall be equipped to meet the instrumentation requirements of Table I.

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5.2.1 (cont'd) The facility shall be equipped with a thrust mount designed for thrust vector determination during steady state operation. The facility shall be equipped with a high natural frequency thrust mount for axial thrust determination during DAT duty cycle operation.

The facility shall be equipped with a TCA firing control system consisting of a pulse generator, automatic tape programmer, TCA control panel, TCA power distribution panel and a regulated DC power supply. The TCA installation wiring is shown in MAC SCD 52701, Revision F, Figure 18. The automatic tape programmer shall be capable of controlling the pulse sequence and duration of Table II.

The facility shall be equipped with a propellant feed system per Figure 6.

5.2.2 Vibration Testing Facility

The facility shall be capable of vibrating the TCA at frequencies of 5 to 2000 cps and at the random vibration power spectral density per Figure 8.

The facility shall be equipped with a servo control unit for varying the vibration frequency logarithmically.

The facility shall be equipped with a Ling ASDE 80 equalization console and a Ling power amplifier to control the random vibration input.

The facility shall be equipped with a test fixture to which the TCA can be attached by employing simulated spacecraft brackets and use of its attach points shown in Figure 7. The test fixture shall be capable of being mounted on the vibration machine such that the TCA can be vibrated along each of the three mutually perpendicular axes shown in Figure 7. Provision shall be made for

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

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5.2.2 (cont'd) attaching the extended propellant valve inlet lines to the test fixture.

The facility shall be equipped with accelerometers with an accuracy of ±5% from 5 to 2000 cps, and a natural frequency over 30,000 cps.

The facility shall be equipped with a multichannel oscillograph for recording the accelerometer output during the vibration sweeps.

The facility shall be equipped with a multichannel FM magnetic tape recorder for recording the accelerometer output during the random vibration.

The facility shall be equipped with a Ballantine True RMS Meter to measure the RMS G acceleration.

The facility shall be equipped with a Technical Products Company analyzer to analyze the accelerometer output power spectral density shape.

5.2.3 Temperature Chamber

An enclosure in which the TCA or the TCA propellant valves can be exposed to air temperatures of -40 to 200F. The temperature chamber shall be capable of maintaining any specified temperature within this range to ±5F. The air temperature shall be continuously recorded. The internal volume shall be sufficient so that all applicable test procedures can be accomplished. Instrumentation shall be provided for continuous recording of chamber temperatures.

5.2.4 Explosion Testing Chamber

An enclosure in which the TCA propellant valves can be exposed

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5.2.4 (cont'd) to a potentially explosive atmosphere, obtained by introducing butane in proper quantity, at simulated pressure altitudes from sea level to 50,000 feet. The facility shall include a spark igniter for demonstrating combustibility of the atmosphere. An environmental temperature of 160 ±5 F shall be required with provision for continuous recording of the air temperature and propellant valve temperature.

5.2.5 Shock Testing Facility

The facility shall be capable of imparting half sine wave shocks of 15 ±1.5 g magnitude and 11 ±1.0 millisecond duration to the TCA.

The facility shall be equipped with a rigid jig test fixture to which the TCA shipping container, as specified in RA0616-008, can be rigidly attached. The rigid jig test fixture shall be capable of being mounted on the shock machine such that the TCA, in its shipping container, can be shocked along the plus and minus direction of each of the three mutually perpendicular axes shown in Figure 7.

The facility shall be equipped with an accelerometer (Statham, Model A5TCA-50-350) which shall be mounted on the rigid jig test fixture.

The facility shall be equipped with an oscilloscope (Tektronix, Model 535 or 564) for monitoring the accelerometer output.

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5.2.6 Electronic Cycler

A device which can be used to cycle the propellant valves at cycle rates of 1,2,3,4 and 5 cycles per second. A cycle shall consist of poppet closed to poppet open to poppet closed. The cycler shall include a counter for counting the cycles.

5.2.7 Electrical Harness

A moisture proof jumper assembly incorporating at one and two Bendix MG06-8-4S plugs potted in accordance with RA0106-006. Each lead shall be identified according to valve (oxidizer or fuel) and pia (A,B,C or D). See Figure I. This electrical harness shall be used whenever electrical power is supplied to the TCA.

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5.3	Standard Pneumatic and Hydraulic Equipment
5.3.1	Pressure Gages
	G_1, G_2 - 0 to 500 psig, ±1/4% accuracy, full scale
5.3.2	Valves
	V_1, V_2 - 1/4" hand valve, 0 to 1000 psig
	V_{10}, - 1/4" hand valve, propellant compatible, 0 to 500 psig
5.3.3	Regulators
	R_1 - 1/4" pressure regulator, 0 to 1000 psig
5.3.4	Filters
	F_1 - Filter, 10 micron absolute, stainless steel wire mesh
	F_2 - Millipore filter, CA12 440 00; Housing, MS 28720-12
5.4	Standard Electrical Equipment
	(Equivalent items may be used)
5.4.1	DC Power Supply - 0 to 36 VDC
5.4.2	AC Power Supply - 110 VAC nominal, 60 cps
5.4.3	Propellant Valve Test Panel - P/N 99-9020285-11
5.4.4	Milliammeter, Model 1951, 0-200 MA range

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5.4.5	Oscilloscope - Hewlett Packard, Model 122 AR, dual trace (for Propellant Valve Functional)	
5.4.6	Oscillograph - 2000 cps frequency response, ± 2% accuracy (for Load Analysis	
5.4.7	Switch - 40 watt minimum power rating	
5.4.8	High Voltage Leak Detector - Associated Research, Model 411	
5.4.9	Impedance Bridge - 0 to 50 ohms, ± 1/10% accuracy	
5.4.10	Voltmeter - Hewlett Packard, Model 412A, 0 to 30 VDC and 0 to 100 VDC, ± 1% full scale accuracy	
5.4.11	Temperature Recorder - Leeds and Northrop, ±3% accuracy	
5.4.12	Thermocouple - Bare wire junction, accuracy class D per RA0201-050	
5.5	Standard Leakage Testing Equipment	
5.5.1	Burette - 25 ml, 0.1 ml graduations	
5.5.2	Beaker - 400 ml	
5.6	Miscellaneous Equipment	
5.6.1	Pressure Test and Water Flow Fixture (Throat Plug) - P/N T5030469	
5.6.2	Camera-Polaroid (with oscilloscope adapter)	

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5.6.3	Propellant Valve Inlet Adapter	
5.6.3.1	Adapter	- Rocketdyne Drawing 99-106126-31
5.6.3.2	Elbow	- McDonnell Drawing 506612-5-5
5.6.3.3	Union	- McDonnell Drawing 506737-5-5
5.6.4	Scale	- 0 to 25 pounds, 0.01 pound subdivisions
5.6.5	Stop Watch	- One second subdivisions
5.6.6	Seal Assembly	- 9017844

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST OPERATIONAL TESTS AND PROCEDURES TEST NO. 207510-401 SHEET 26 OF 171

Reference: MAC SCD 52-52701, Revision F

5.0 Operational Tests and Procedures

This section contains those procedures which shall be used in conjunction with the Environmental and Service Life Tests to demonstrate SCD compliance.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 207510-101 SHEET 27 OF 174

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.1

6.1 Propellant Valve Proof Pressure and Leakage

6.1.1 Install the TCA in a test setup as shown in Figure 2. If the propellant valves have been removed from the TCA, they shall be equipped with propellant valve outlet adapters. Do not attach the leakage sensing line at this time.

NOTE: It shall be necessary to perform this test in a hazardous test cell. See paragraph 3.8.

6.1.2 Slowly adjust the regulated helium supply pressure at the oxidizer propellant valve inlet to 500 $^{+10}_{-0}$ psig as indicated by the pressure gage.

6.1.3 Maintain this pressure for a period of not less than three minutes.

6.1.4 De-pressurize the oxidizer propellant valve.

6.1.5 Adjust the regulated helium supply pressure to 150 $\pm$10 psig.

6.1.6 Adjust the DC power supply to 26 $\pm$0.5 VDC.

6.1.7 Cycle the oxidizer propellant valve three times and leave in the closed position.

6.1.8 Attach the leakage sensing line and arrange the leakage testing equipment as shown in Figure 2.

6.1.9 Adjust the regulated helium supply pressure to 500 $^{+10}_{-0}$ psig.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 207510-401 SHEET 28 OF 171

6.1.10 At first indication of leakage, wait at least two minutes to insure a steady leakage rate and then measure the leakage over a period of at least five minutes with a stopwatch. If no leakage is apparent after five minutes or if the measured leakage is less than 0.5 ml, record the leakage rate as "less than 0.1 scc He/MIN". The maximum allowable leakage is 2.23 scc He/MIN.

6.1.11 De-pressurize the oxidizer propellant valve. Disconnect the helium supply line, the DC power supply and the leakage sensing line. Cap the oxidizer propellant valve inlet port and electrical receptacle.

6.1.12 Failure to pass the above tests shall constitute a failure of the oxidizer valve. See paragraph 3.6.1.

6.1.13 Repeat the above procedure on the fuel propellant valve.

6.1.14 Remove the TCA from the test setup. Replace all protective covers.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 85# — PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST: THRUST CHAMBER PROOF PRESSURE AND LEAKAGE — TEST NO. 207510-401 SHEET 29 OF 171

Reference: MAC SCD 52-52701 Revision F, paragraph 6.2.3.1

6.2 Thrust Chamber Proof Pressure and Leakage

6.2.1 Install the TCA in a test setup as shown in Figure 3.
NOTE: It shall be necessary to perform this test in a hazardous test cell. See paragraph 3.8.

6.2.2 Close Valve V_1.

6.2.3 Apply leak test compound to all welds on the TCA and to the transition joint between the stainless steel shell and the ablative material on the TCA nozzle exterior.

6.2.4 Energize the fuel propellant valve with 12 ±2 VDC

6.2.5 Slowly increase the regulated GN_2 supply pressure to 392±10 psig. Maintain this pressure for a period of $3^{+.25}_{-0}$ minutes. Evidence of leakage in the areas specified in paragraph 6.2.3 shall constitute a failure of the TCA.

6.2.6 Reduce the regulated GN_2 pressure to zero and de-energize the fuel valve.

6.2.7 Repeat paragraphs 6.2.3 through 6.2.6.

6.2.8 Failure to pass the above test shall constitute a failure of the TCA.

6.2.9 Wash residual leak test compound from the TCA with water and blow dry with GN_2.

6.2.10 Remove the TCA from the test setup and re-install all protective closures.

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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO. 207510-401 SHEET 30 OF 171

Reference: MAC SCD 52-52701 Revision F, paragraph 6.2.3.2

6.3 Propellant Valve Electrical Resistance

6.3.1 Install the electrical harness on the propellant valves Provide an environmental temperature of 70±10F.

6.3.2 Adjust the impedance bridge to measure resistance.

6.3.3 Measure and record the resistance between leads A and B of the oxidizer valve. The acceptable resistance is as shown on Figure 30. A

6.3.4 Measure and record the resistance between leads C and D of the oxidizer valve. The maximum acceptable resistance is 1.0 ohm.

6.3.5 Repeat paragraphs 6.3.3 and 6.3.4 on the fuel valve.

6.3.6 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.

6.3.7 Remove the electrical harness from the propellant valves and reinstall the protective covers on the propellant valve electrical connectors.

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REVISION A J. D. Mangosonis Dated 10-3-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 85# — PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST: PROPELLANT VALVE DIELECTRIC STRENGTH — TEST NO. 207510-401 SHEET 31 OF 171

Reference: MAC SCD 52-52701 Revision F, paragraph 6.2.3.3

6.4 Propellant Valve Dielectric Strength

6.4.1 Install the electrical harness on the propellant valves. Attach ground leads to each of the propellant valve electrical connector bodies by means of alligator clips.

6.4.2 Adjust the 60 cps AC voltage output of the leakage tester to zero.

6.4.3 Set the capacity compensation selector switch on the leakage tester to "NONE".

6.4.4 Connect one of the leakage tester leads to lead A of the oxidizer valve and the other lead to the oxidizer valve ground lead.

6.4.5 Depress power switch on the leakage tester, and adjust the voltage control until 500^{+10}_{-0} VRMS is indicated on the voltmeter. If the leakage tester ammeter reads off-scale, reduce the voltage until approximately 800 microamps is indicated on the ammeter.

6.4.6 Rotate the capacity compensation selector switch until a minimum current flow is indicated on the ammeter.

6.4.7 Adjust the voltage control until 500^{+10}_{-0} VRMS is indicated on the voltmeter.

6.4.8 Observe the ammeter for a period of one minute. Maximum allowable current leakage is 500 micro-amps.

6.4.9 Release the leakage tester power switch and disconnect the leakage tester leads.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PROPELLANT VALVE DIELECTRIC STRENGTH — PART NO. MAC 52-52701-275, NAA 207510-21

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6.4.10	Repeat paragraphs 6.4.2 and 6.4.3.
6.4.11	Connect one of the leakage tester leads to lead C of the oxidizer valve and the other lead to the oxidizer valve ground lead.
6.4.12	Repeat paragraphs 6.4.5 through 6.4.9.
6.4.13	Repeat paragraphs 6.4.2 and 6.4.3.
6.4.14	Connect one of the leakage tester leads to lead A of the oxidizer valve and the other to lead C of the oxidizer valve.
6.4.15	Repeat paragraphs 6.4.5 through 6.4.9.
6.4.16	Failure to pass the above test shall constitute a failure of the oxidizer valve. See paragraph 3.6.
6.4.17	Repeat paragraphs 6.4.2 through 6.4.16 on the fuel valve.
6.4.18	Remove the electrical harness and the ground leads from the propellant valves and replace the propellant valve protective covers.

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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 854 PART NO. {MAC 52-52701-275 / NAA 207510-21

TEST NO. PROPELLANT VALVE FUNCTIONAL SHEET 33 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.1

6.5 Propellant Valve Functional

6.5.1 Install the TCA in a test setup as shown in Figure 4. Provide a temperature environment of 70 ±5 F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than ±3 F for a 30 minute time period. Connect the current trade lead to the oxidizer valve. Do not connect the voltage trace lead.

6.5.2 Adjust the pressure regulator to obtain 300 ±10 psig on the pressure gage.

6.5.3 Adjust the DC power supply so that 26 ±0.5 VDC is read on the voltmeter.

6.5.4 Close the mercury switch and record the oscilloscope current trace with the Polaroid camera. A sample current trace is shown in Figure 5. The maximum valve opening response time is 0.021 seconds from electrical signal to poppet open. See Figure 5 for typical valve opening response characteristics. Open the mercury switch.

6.5.5 Reduce the GN_2 supply pressure to zero.

6.5.6 Disconnect the current trace lead and connect the voltage trace lead.

6.5.7 Close the mercury switch to verify that the oxidizer valve has opened. Then open the mercury switch and record the oscilloscope voltage trace with the Polaroid camera. A sample voltage trace is shown in Figure 5. The maximum valve closing response time is 0.075 seconds from electrical signal to poppet closed.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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6.5.8	Adjust the GN_2 supply pressure to 300 ±10 psig.
6.5.9	Adjust the DC power supply voltage to zero.
6.5.10	Close the mercury switch.
6.5.11	Increase the DC power supply voltage until the oxidizer valve opens as indicated by a pressure drop. The maximum acceptable pull in voltage is 16 VDC as indicated on the output voltmeter.
6.5.12	Reduce the GN_2 supply pressure to zero.
6.5.13	Reduce the DC power supply voltage until the propellant valve closes. Note deflection on milliammeter which indicates valve closing. Record valve closing voltage. The minimum acceptable drop out voltage is 1.0 volts.
6.5.14	Open the mercury switch.
6.5.15	Failure to pass the above test shall constitute a failure of the oxidizer valve. See paragraph 3.6.
6.5.16	Repeat paragraphs 6.5.1 through 6.5.15 on the fuel propellant valve.
6.5.17	Remove electrical leads and the GN_2 supply.
6.5.18	Replace all protective closures.

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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST WEIGHT DETERMINATION TEST NO. 207510-401 SHEET 35 OF 174

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.4.1

6.6 Weight Determination

6.6.1 Weigh the TCA to the nearest one-hundredth (0.01) pound in accordance with RAO 220-290 and record.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST CHAMBER ASSEMBLY FIRING PROCEDURE TEST NO. 207510-401 SHEET 36 OF 171

Reference: MAC SCD 52-52701 Revision F, paragraph 6.3.1.3.2.2

6.7 Thrust Chamber Assembly Firing Procedures

6.7.1 Inspect TCA for proper location of combustion chamber liner chamber pressure hole, using a source light.

6.7.2 Install the TCA in the applicable thrust mount located in a hot fire test installation equipped with instrumentation per Table 1. The required propellant feed system is shown schematically in Figure 6. Pressure check all connections using GN_2 at 50 ±10 psig, seal assembly 9017844, and leak test compound.

6.7.2.1 For cape cycle firings, the firing duration shall be controlled automatically.

6.7.2.2 For thrust vector firings the firing duration shall be controlled automatically. The TCA shall be equipped with instrumentation for determining the direction of the thrust vector with respect to the longtiudinal axis of the TCA. See Figure 13.

6.7.2.3 For DAT duty cycle firings the firing control shall be automatic. The pulse sequence and duration shall be according to the schedule of Table II.

6.7.3 Open facility propellant valves.

6.7.4 Pressurize facility propellant tanks to approximate run pressures. A

6.7.5 Open the oxidizer bleed valve to bleed entrained gas from the oxidizer feed system. Continue bleeding until entrained gas is eliminated as evidenced by a steady oxidizer flowmeter signal.

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REVISION A J. D. Mangano Dated 9-12-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

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6.7.6 Close oxidizer bleed valve.

6.7.7 Repeat paragraphs 6.7.5 and 6.7.6 on the fuel feed system.

6.7.8 Activate altitude chamber to achieve and maintain a simulated pressure altitude of 100,000 feet or greater. If the firing is to be cape cycle the pressure altitude shall be local ground level.

6.7.9 Make final propellant tank pressure adjustments to obtain the required TCA inlet pressures during steady state operation as follows:

Oxidizer Inlet Pressure	285 ±10 psia
Fuel Inlet Pressure	287 ±10 psia

6.7.10 Turn on instrumentation. The parameters tabulated in Table I shall be monitored and recorded during the hot fire test. A

6.7.11 Fire TCA as required to accomplish test objectives.

6.7.12 Immediately following termination of firing reduce pressure altitude to local ground level conditions. Close the facility propellant valves and adjust GN_2 purge pressurant to 120 ±10 psig.

NOTE: (1) Maintain altitude following the completion of the DAT Duty Cycle to minimum duration. Record temperature data during the soak out period of 20 ±5 minutes. After soak out temperature is reached complete the Hot Fire Burst Pressure Test procedure of paragraph 7.2.4. TCA skin temperature must not exceed 700 °F after MDC soakout.

(2) Maintain altitude following the completion of the DAT Duty Cycle to Guaranteed Life. Record temperature data during the soak out period of 20 ±5 minutes. No failure criteria shall be attached to the soakout temperature after the MDC to guaranteed life. A

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Rev. A D. Montgomery Date 7-17-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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NAME OF TEST: THRUST CHAMBER ASSEMBLY FIRING PROCEDURE — TEST NO. 207510-401 SHEET 38 OF 171

6.7.13 Open the propellant bleed valves and purge with GN_2 for a period of 30 seconds (minimum). A

6.7.14 Close the propellant bleed valves.

6.7.15 Cycle the TCA oxidizer and fuel valves three times simultaneously and leave in the open position.

6.7.16 Continue to purge for two minutes.

6.7.17 Close the TCA oxidizer and fuel valves.

6.7.18 Secure the test facility.

6.7.19 Remove the TCA from the Hot Fire Test installation. A

PREPARED BY: T.G. Kniffin	DATE 9-8-64	APPROVED FOR NAA:	DATE 9-9-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 9-14-64				

FORM 608-B-38 NEW 6-63

Rev. A J. D. Margai Date 9-17-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207510-401 SHEET 12 OF 177

6.8 Decontamination Procedure

6.8.1 The TCA shall be decontaminated as follows, using a hot GN_2 purge and anhydrous isopropyl alcohol, reagent grade, ACS, for the fuel side flush and freon TF for the oxidizer side flush.

NOTE: The hot GN_2 purge may be accomplished at the hot fire test facility.

6.8.2 Attach 26 VDC (nominal) electrical power supply leads to the TCA electrical connectors.

6.8.3 Connect GN_2 purge line to the oxidizer valve inlet. See paragraph 3.8.

6.8.4 Open the GN_2 supply valve and purge the oxidizer side for ten minutes using 12 ±2 VDC to open the oxidizer valve. C

NOTE: The GN_2 pressure and temperature, at the valve inlet, shall be 120 ±20 psig and 160 ±20°F.

6.8.5 Open the GN_2 supply valve and purge the oxidizer side as follows for ten (10) cycles, using 26 ±1 VDC. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

NOTE: The GN_2 pressure and temperature will be the same as paragraph 6.8.4.

6.8.6 Close the GN_2 supply valve and vent the GN_2 downstream of the supply valve.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE				

FORM 608-B-38 NEW 6-63

Rev. C J. D. Haroggens dated 10/21/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207510-401 SHEET 40 OF 171

6.8.7 Disconnect the supply line from the oxidizer valve.

6.8.8 Cap the valve adapter.

6.8.9 Repeat paragraph 6.8.1 through 6.8.8 on the fuel valve.

6.8.10 Install the TCA in the decontamination facility.

6.8.11 Attach the facility alcohol supply line to the TCA fuel valve inlet. See paragraph 3.8.

6.8.12 Cap the TCA oxidizer inlet line and the chamber pressure instrumentation tap.

6.8.13 Install the electrical harness on the propellant valves and connect the harness to the DC power supply.

6.8.14 Energize the TCA fuel valve to the open position with 12 ±2 VDC.

6.8.15 Flow alcohol through the TCA for 2 $^{+1}_{-0}$ minutes. The alcohol shall be flowed at a TCA inlet pressure of 35 to 50 psig.

6.8.16 Flow alcohol through the TCA as follows for ten (10) cycles, using 26 ±1 VDC at a TCA inlet pressure of 35 to 50 psig. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

6.8.17 De-energize the TCA fuel valve to closed position and vent the alcohol supply system.

6.8.18 Remove the facility alcohol line and attach the GN_2 supply line to the TCA fuel valve.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: J.D. Mangenis	DATE 10-20-64		10-20-64		

FORM 608-B-38 NEW 6-63

Rev. C J.D. Mangenis dated 10/21/64

P/24/4

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21-401

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207510 SHEET 41 OF 171

6.8.19 Energize the TCA fuel valve to the open position with 12 ±2 VDC.

6.8.20 Purge the TCA with GN_2 at pressure of 120 ±10 psig for 3 minutes.

6.8.21 Cycle valve ten (10) times with GN_2 at pressure of 120 ±10 psig as follows using 26 ±1 VDC. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

6.8.22 De-energize the TCA fuel valve to the closed position.

6.8.23 Disconnect GN_2 line from TCA fuel valve and cap the fuel valve inlet.

6.8.24 Remove cap from TCA oxidizer valve inlet.

6.8.25 Attach Freon TF supply line to TCA oxidizer valve inlet.

6.8.26 Energize TCA oxidizer valve to open position with 12 ±2 VDC.

6.8.27 Flow Freon TF through the TCA for 2 ±1 minutes. The freon shall be flowed at a TCA inlet pressure of 35 to 50 psig.

6.8.28 Flow Freon TF through the TCA as follows for ten (10) cycles, using 26 ±1 VDC at a TCA inlet pressure of 35 to 50 psig. C

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

6.8.29 De-energize TCA oxidizer valve to closed position and vent the Freon supply system.

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
R. Cole	R. Hecht 10-20-64	
CHECKED BY: DATE		
R. Simms 10-20-64		

FORM 608-B-38 NEW 6-63

Rev. C J. D. Barrageno dated 10/21/64

10/14/64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 207510-401 SHEET 41.1 OF 171

6.8.30 Disconnect Freon Supply line and attach GN_2 supply to TCA oxidizer inlet.

6.8.31 Energize the TCA oxidizer valve to open position with 12 ±2 VDC.

6.8.32 Purge the TCA with GN_2 at a pressure of 120 ±10 psig for 3 minutes.

6.8.33 Cycle valve ten (10) times with GN_2 at pressure of 120 ±10 psig as follows using 26 ±1 VDC.

(a) 5 ±1 seconds on-time
(b) 5 ±1 seconds off-time

6.8.34 De-energize the TCA oxidizer valve to closed position and remove the electrical harness.

6.8.35 Remove the GN_2 supply line from the TCA oxidizer valve and remove the cap from the fuel valve inlet.

6.8.36 Install throat plug and connect vacuum equipment to the throat plug port and the propellant valve inlets.

6.8.37 Operate the vacuum equipment so that the TCA is subjected to an internal pressure of 1.0 psia or less for a period of not less than fifteen minutes. The propellant valves and injector shall be heated and maintained at a temperature of 160 ±10 F for the entire fifteen minute period.

6.8.38 Remove the throat plug and the vacuum lines from the TCA.

6.8.39 Replace all protective closures.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: K.T. Dennis	DATE 10-20-64	R.F. Hoide	10-20-64		

FORM 608-B-38 NEW 6-63

Rev. C J.D. Mangaris dated 10/21/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207510-401 SHEET 41.2 OF 171

6.9 Propellant Valve Orifice Removal

6.9.1 Remove oxidizer and fuel valve tube assemblies (P/N 407572) from TCA.

6.9.2 Remove retaining rings and orifices.

NOTE: Use caution in removing orifice to prevent damage. (Reference paragraph 3.8 for cleanliness requirements)

6.9.3 Package and identify each orifice and retaining ring.

6.9.4 Reweld tube assemblies to the propellant valves.
NOTE: Orient propellant valve inlet adapters per Figure 11B. A

6.9.5 Secure packaged orifices and retaining rings to the applicable valves.

6.9.6 Perform 500 psig leak check to verify structural integrity of weld joints.

6.9.7 Reidentify TCA 207510-21 as 207510-21 DAT.

PREPARED BY: E. Adams	DATE 9-30-64	APPROVED FOR NAA: R Heide	DATE 10-8-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: R Cobb	DATE 10-8-64				

FORM 608-B-38 NEW 6-63

Rev. A L. D. Morgan dated 10-12-64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207510-401 SHEET 42 OF 171

Reference: MAC SCD 52-52701, Revision F, Figure 12

4.0 Environment and Service Life Tests

In this section the required environment, service life, and operational tests are specified for each of the three TCA's. Sheets are provided for the recording of environmental and service life data and the data of the operational tests required to demonstrate specification compliance.

PREPARED BY: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/17	4-18-64			

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207510 SHEET 43 OF 171

Reference: MAC SCD 52-52701, Revision F, Figure 12

7.1 Thrust Chamber Assembly Number 1

This sub-section specifies the tests which are to be performed on Thrust Chamber Assembly No. 1.

PREPARED BY: E. Adams DATE 4/15/64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: DATE 4/17	4-18-64	

FORM 608-B-38 NEW 6-63

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. AC 5121 [illegible]

Dwg. No. 207510-21

Model SM-7 85 [illegible]

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
IF 1	ANH 9/11	PART NO. EXTENDED INLET TUBE ADAPTERS INSTALLED ON PROPELLANT VALVES HAVE NO INSPECTION VERIFICATION OR IDENTIFICATION AND ARE REF PARA 2.11.2.2 & 2.11.2.2.2			
ACTION TAKEN		TUBE ASSEMBLIES IDENTIFIED & VERIFIED BY INSPECTION. TUBE ASSY FORMATION DETERMINED BY MOCKUP.	ANH 9-31-64		
IF 2	[illegible] 9/11	PART NO. GENERAL: NAME PLATE APPROX. 6" FROM EXHAUST END IS DAMAGED AND HAS NO INSPECTION VERIFICATION REF PARA 2.11.2.1			
ACTION TAKEN		TRANSFERRED TO SHORTAGE	[illegible] 9-31-64		
IF 3	ANH 9/28	PART NO. GENERAL: REMOVED AND RE-INSTALLED EXTENDED PROPELLANT VALVE INLET ADAPTERS AND REPLACED EXTENDED PROPELLANT VALVE INLET ADAPTERS PER MAC INSTRUCTIONS			
ACTION TAKEN					
	/	PART NO. AND RAO 607-009. REF IL DATED 7-28-64, REF 2.11.2.2. O.K. as is J.H. Knoell - S.E. Weddell 9/25/64			
ACTION TAKEN		INFORMATION ONLY NO ACTION REQUIRED.	ANH 815 9/28	ANH 9/28	9/28
[illegible]	[illegible] ANH 9/30	PART NO. [illegible]			
ACTION TAKEN		INFORMATION ONLY	OCT 2 [illegible] ANH 9/30	OCT 23 [illegible] 9/30	OCT 24 [illegible]

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25-- Rev. 12-57

R-15019-2

UNIT 2-1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4051207

Dwg. No. 207370-21

Model 85% TCI

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
		C+L III 5/5			
		PART NO.			
		Insp. Complete [illegible] 3			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			

10-24-64 K 85# Mouse

DAT. 207510-31 4051207
UNK
407561 4057605
407662 4057623

091 start 1028 6.0sec Amb Cape cycle
stop 1103

092 start 1246 365.0sec 150,000 M.D.C. To Failure
stop 1255

OK

OK.

6723
6723
6724
6724
4213

See Note *

2927 2860

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5400

Deviation Request:

It is hereby authorized to replace the extended propellant valve inlet adapters (9/19/64) and replace with extended valve inlet adapters as per McDonnell instruction on TCA P/N 207510-21, S/N 4051207.

Recopied from original request dated 28, September 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

Original Signed by
V. E. Padilla
MAC Engrg

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

R-10519-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 44 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.2.1

7.1.1 Pre- Test Inspection - TCA #1

7.1.1.1 Test Procedure

7.1.1.1.1 Verify that the TCA is of the proper configuration, that it has been properly packaged and that it contains no defects such as broken parts, corrosion, damage or deterioration. Also verify that the TCA has passed the acceptance tests of RA0220-348. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.1.1.1.2 Braze the extended propellant valve inlet adapters (P/N 99-106688 and 99-106689) to the oxidizer and fuel propellant valves per RA0607-009. Remove after vibration test and braze basic inlet tube adapter (99-106126) to TCA. See Figure 11 and 11A.

7.1.1.1.3 Perform weight determination on TCA with basic inlet tube adapters per paragraph 6.6.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	8/10/64	R. A. Gibbs	8-12-64		
CHECKED BY:	DATE				
W. [illegible]					

FORM 508-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510 SHEET 45 OF 171

7.1.1.2 Test Data - TCA #1

7.1.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-275		
Rocketdyne Part No.	207510-21	407561	407662
Component Serial No.	4057207	4057605	4057623

7.1.1.2.2 Inspection (reference paragraph 7.1.1.1)

7.1.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, that it had been properly packaged and that it contained no defects such as broken parts, corrosion, damage or deterioration. Also the TCA records were inspected and it was verified that the TCA had passed the acceptance tests of RA0220-348 YES (yes or no). 10/12 (ANR 815) REF DCP #2

7.1.1.2.2.2 The extended inlet tube adapters were installed on the propellant valves per paragraph 7.1.1.1.2 for vibration tests only. YES (yes or no) (BJB) 10/12 (ANR 815) REF DCP #1 REF DCP #3

7.1.1.2.2.3 The extended inlet tube adapters were removed from the propellant valves following the vibration tests and the basic inlet tube adapters installed on the TCA. YES (yes or no) (ANR 815)

7.1.1.2.2.4 Inspection Remarks

NONE 10/12/64 (ANR 815)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 6-29-64	(BJB) 10/12/64	Eugene Triconi 10/12 (ANR 815)	WAIVED BY ROCKSTEIN (ANR 815) 10/12
			VERIFIED BY USAF / DATE: R M Clyn 10/13/64

WAIVED BY MACENTARFER BY TELECON 10-12-64 (ANR 815)

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 46 OF 171

7.1.1.2.3 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA YES (Yes or No).

The TCA dry weight was 11.20 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

NONE 10-13-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	W. H. Davis 10-13-64	D. Kaye 10-13-64	WAIVED BY S. HAVROGEN 10-13-64
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5401

Deviation Request:

Six (6) strain gages were mounted on TCA inlet tubes to record amplitude during vibration testing in the X, Y and Z Axis.

Recopied from original request dated 1, October 1964.

James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5402

Deviation Request:

The Propellant Valve Proof Pressure Test of paragraph 7.1.2.1.7 shall be performed in Vibration Room #1 (Canoga Facility) following random vibration tests in the X and Y Axis.

Recopied from original request dated 1, October 1964.

James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5403

Deviation Request:

Accelerometer mounted on injector end of TCA was relocated 180° because of interference with MAC TCA shell support brackets.

Recopied from original request dated 1, October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5404

Deviation Request:

Final Power Spectral Density Analysis in the Y-Axis was out of tolerance in the 625 to 710 cps range per figure 8. It peaked out at 690 cps at .053 g^2/cps. Received verbal authorization from MAC Engineering to continue random dwell in Y-Axis.

Recopied from original request dated 2, October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-2-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5405

Deviation Request:

For data Reduction Analysis changed sample #2 and #3 to read 3 and 6 minutes, respectively. (Reference paragraph 7.1.2.2.3.6) . Change required because of Equalization Test duration (66 seconds).

Recopied from original request dated 2, October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5406

Deviation Request:

TCA Proof Pressure Test of paragraph 6.2.3 will be deviated and leak test compound will be applied to exit nozzle shell and ablative only because of interference of MAC support mounting brackets and valve supporting brackets on TCA.

Recopied from original request dated 3, October 1964.

James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 47 OF 171

REFERENCE: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.17.3

7.1.2 Vibration - TCA #1

7.1.2.1 Test Procedure

7.1.2.1.1 Install the TCA into the vibration test facility. The direction of the vibration input shall be along the X axis of the TCA (see Figure 7).

NOTE: Remove nameplate and mount accelerometer. Replace nameplate at new location on TCA.

7.1.2.1.2 Perform a sine wave survey on the thrust chamber.

7.1.2.1.2.1 The survey shall be a one (1) G maximum peak logarithmic sweep from 5 to 2000 cps in 5 ±1 minutes.

7.1.2.1.2.2 Record the input and output accelerations on an oscillograph recorder.

7.1.2.1.3 Perform a ten (10) second vibration table equalization run at the test level to verify spectrum shape and tolerance.

7.1.2.1.3.1 Record and analyze the data.

7.1.2.1.3.2 The random vibration input shall be per Figure 8.

7.1.2.1.3.3 The power spectral density is to be the specified value with a plus forty (40) percent and minus thirty (30) percent tolerance when analyzed with 1/3 - octave or narrower filters.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	8-7-64				
CHECKED BY:	DATE				
	8-12-64		8-12-64		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 48 OF 171

7.1.2.1.3.4	The overall RMS acceleration level is to be 9.6 G's plus fifteen (15) percent, minus zero (0) percent.	
7.1.2.1.3.5	No smaller than three (3) sigma clippers shall be used to limit the input level.	
7.1.2.1.4	Readjust the controls and repeat paragraphs 7.1.2.1.3 and 7.1.2.1.3.1 as required to conform to paragraphs 7.1.2.1.3.2 through 7.1.2.1.3.4.	
7.1.2.1.4.1	Full level equalization time for the purpose of verifying the spectrum shape shall not exceed twenty (20) percent of total test duration for each individual axis.	
7.1.2.1.5	Vibrate the TCA with the random vibration input established in paragraph 7.1.2.1.4 for a duration of eight (8) ± 0.1 minutes less the time accumulated, for each respective axis, in paragraphs 7.1.2.1.3 and 7.1.2.1.4.	
7.1.2.1.5.1	Record and analyze the input and output accelerations at selected intervals.	
7.1.2.1.6	Remove the TCA from the test setup.	A
7.1.2.1.7	Perform 6.1 thru 6.14 of the Propellant Valve Proof Pressure and Leakage Test for both valves.	A
7.1.2.1.8	Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.7 except that the direction of vibration input shall be along the Y axis (see Figure 7).	A
7.1.2.1.9	Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.6 except that the direction of vibration input shall be along the Z axis (see Figure 7).	A

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	9-26-64	R. Forde	9-26-64		
CHECKED BY:	DATE				
[illegible]	9-26-64				

FORM 608-B-38 NEW 6-63
Revision A J. D. Marrogens Date 9-25-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST VIBRATION TEST NO. 207510 SHEET 49 OF 171

7.1.2.1.10	Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.
7.1.2.1.11	Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.
7.1.2.1.12	Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.
7.1.2.1.13	Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.
7.1.2.1.14	Perform Propellant Valve Functional Test per paragraph 6.5.
7.1.2.1.15	Remove extended inlet tube adapters and install basic inlet tube adapters per paragraph 7.1.1.1.2.
7.1.2.1.16	Perform weight determination per paragraph 7.1.1.1.3

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	9-26-64	B. H. Wride	9-26-64		
CHECKED BY:	DATE				
	9-26-64				

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 50 OF 171

7.1.2.2 Test Data - TCA #1

7.1.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. [illegible] 2701-275 (ANR 941)

Rocketdyne Part No. [illegible] 5[illegible] 21 (ANR 941)

Component Serial No. [illegible] 1205 1201 (ANR 941)

7.1.2.2.2 Accelerometer Identification (Reference Figure 7)

Location	Sensitive Axis	Identification No.
TCA Input	X	113 (ANR 941)
TCA Input	Y	[illegible] (ANR 941)
TCA Input	Z	[illegible] (ANR 941)
TCA Shell at Comb. Zone	X	[illegible] (ANR 941)
TCA Shell at Comb. Zone	Y	[illegible] (ANR 941)
TCA Shell at Comb. Zone	Z	[illegible] (ANR 941)
TCA Shell at Exit	X	[illegible] (ANR 941)
TCA Shell at Exit	Y	[illegible] (ANR 941)
TCA Shell at Exit	Z	[illegible] (ANR 941)

A A A

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T.G. Kniffin 7-9-64	[illegible] 10/1	[illegible] 10/1/64 (ANR 941)	WAIVED 10/1/64 BY J.D. MAURIGENIS
			VERIFIED BY USAF / DATE [illegible] 10/1/4

FORM 608-B-39 NEW 6-63

REVISION A J.D. Maurigenis Dated 8-31-64

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST VIBRATION TEST NO. 207510 SHEET 51 OF 171

7.1.2.2.3 Vibration Test (Reference paragraph 7.1.2.1)

7.1.2.2.3.1 Resonant Survey - X Axis

Freq. cps	Input g's	Output g's	Identification (no)
325	1.0	16.0	S/N 1228
410	1.0	7.0	S/N 1127
447	1.0	11.0	S/N 1073
575	1.0	7.0	S/N 1073
905	1.0	6.5	S/N 1228
950	1.0	6.0	S/N 1228
1045	1.0	4.0	S/N 1228
1800	1.0	5.5	S/N 1431

7.1.2.2.3.2 Vibration Table Equalization Test - X Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	9.6	12	12
2	YES	9.6	12	24

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
T.G. Kniffin 7-9-64	10-1-64 M.J. Lulla 2315	M. J. Fogarty 10/1/64	WAIVED 10/1/64 BY J.D. MAVROGENIS
			VERIFIED BY USAF 10/1/64 DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 2075.10-21

NAME OF TEST: VIBRATION TEST NO. 2075.10-701 SHEET 52 OF 171

7.1.2.2.3.3 Random Vibration Test - X Axis

Accelerometer outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 ±0.5 Minute) 1.0
SAMPLE #2 (4 ±0.5 Minutes) 4.0
SAMPLE #3 (7 ±0.5 Minutes) 7.0

The elapsed time at test cutoff was 8.0 minutes.

Results of the Analysis:

SAMPLE #1 within +40%, -30% ok

SAMPLE #2 within +40%, -30% ok

SAMPLE #3 within +40%, -30% ok

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	J.A. Doyle	10-16-64	J.T. Mendelson	10-16-64	J. Marrotteni	10-16-64
						VERIFIED BY USAF	DATE
						R.M. Clymer	10/19/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 854 PART NO. { MAC 52-52701-275 / NAA 3075[illegible]-21 -103

NAME OF TEST VIBRATION Y AXIS TEST NO. 20[illegible]10 SHEET 52 OF 171

7.1.[illegible].3.10 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes

Inspection Remarks

No Leakage

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED/FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
R. Cole	M. KING 10/2/64	F. N. Haselhorst 10/2/64	WAIVED BY J. MAVROGENIS 10/5/64
			VERIFIED BY USAF 10/5/64 DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 55 OF 171

7.1.2.2.3.7 Resonant Survey - Z Axis

Freq. cps	Input g's	Output g's	Identification (no.)
140	1.0	28.0	S/N 944
250	1.0	20.0	S/N 1005
345	1.0	3.0	S/N 1005
360	1.0	4.4	S/N 1005
355	1.0	8.0	S/N 744
960	1.0	4.0	S/N 1228
1150	1.0	3.6	S/N 1228
1240	1.0	5.0	S/N 1228

10-2-64

7.1.2.2.3.8 Vibration Table Equalization Test - Z Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	No	9.6	10 SEC	10 SEC
2	YES	9.6	10 SEC	20 SEC

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T.G. Kniffin 7-9-64	10-5-64 W/J Lieber 2315	10-2-64 J. Vaughn	WAIVED 10-2-64 BY R. FREE
			VERIFIED BY USAF / DATE: A L Stephens 10/5/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 56 OF 171

7.1.2.2.3.9 Random Vibration Test-Z Axis

Acceleration outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 ±0.5 Minute) 1.0
SAMPLE #2 (4 ±0.5 Minutes) 4.0
SAMPLE #3 (7 ±0.5 Minutes) 7.0

The elapsed time at test cutoff was 8.0 minutes. 10-2-64

Results of the Analysis:

SAMPLE #1 within +40%, -30% ok

SAMPLE #2 within +40%, -30% ok

SAMPLE #3 within +40%, -30% ok

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T.G. Kniffin	7-9-64	L.A. Doyle	10-16-64	J.F. Murchison	10-16-64	Walter Ely for J.F. Murchison	10-16-64
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 57 OF 171

7.1.2.2.3.10 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	<.1 scc He/min	<.1 scc He/min

Inspection Remarks

NONE 10-3-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	10-3-64	10-3-64	WAIVED BY J. MAVROGENIS 10-3-64
			VERIFIED BY USAF 10/3/64 DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 58 OF 171

7.1.2.2.3.11 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure	1st Application	2nd Application
Pressure (392 ±10)	390 psig	[illegible] psig
Time Duration (3 ±0.25)	3 minutes	3 minutes
Voltage (12±2)	12 VDC	12 VDC

SEE I&L DATED 10-3-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	T. J. Pope 10-3-64	10-3-64	WAIVED BY J. MAVRUGENIS 10-3-64
			VERIFIED BY USAF 10/3/64 DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 59 OF 171

7.1.2.2.3.12 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 41.8 ohms (Acceptable per Figure 10, yes or no YES).

Fuel Valve 41.7 ohms (Acceptable per Figure 10, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .164 ~~.224~~ ohms

Fuel Valve .150 ohms

Inspection Remarks

NONE 10-3-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	10-3-64	10-3-64	VERIFIED BY USAF 10/3/64 / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 60 OF 171

7.1.2.2.3.13 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	VRMS	Oxidizer Valve Voltage Volts 500 +10 -0	Oxidizer Valve Current Microamps 500 max.	Fuel Valve Voltage Volts 500 +10 -0	Fuel Valve Current Microamps 500 max.
A to Ground	500	46		500	47
C to Ground	500	67		500	62
A to C	500	27		500	26

Inspection Remarks

NONE 10-3-64

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams EA 1/15/64	F. B. Pape 10-3-64	10-3-64	WAIVED BY J. MAVROGENIS 10-3-64
			VERIFIED BY USAF 10/3/64 DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
E. Pope	585586	ENV.LAV.	2061	10-5-64
PART	**PART NO.**	**TYPE OF TEST**		
85# OAMS TCA UNIT #1	207510-21 S/N 4051207	POST VIBRATION FUNCTIONAL		

OXIDIZER VALVE

P/N 407561 S/N 4057605

CURRENT TRACE

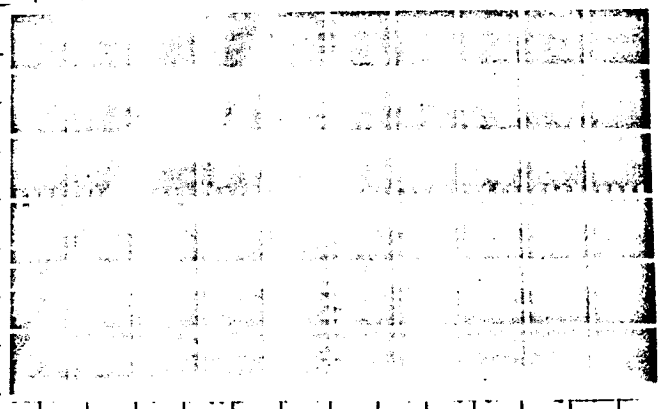
(OPENING TIME)

Horizontal = 5 ms/cm

Vertical = 10 mv/cm

Requirement = 0.021 sec/max

Actual = 0.0165 sec



VOLTAGE TRACE

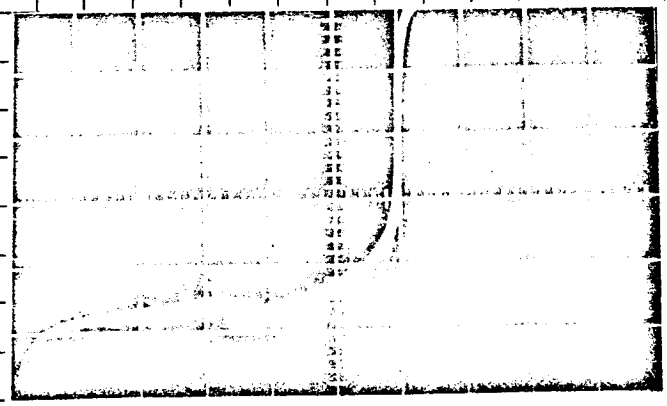
(CLOSING TIME)

Horizontal = 20 ms/cm

Vertical = 200 mv/cm

Requirement = 0.075 sec/max

Actual = 0.068 sec



PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	585586	ENV.LAB.	2061	10-5-64

PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #1	207510-21 S/N 4051207	POST VIBRATION FUNCTIONAL

FUEL VALVE

P/N 407662 S/N 4057623

CURRENT TRACE

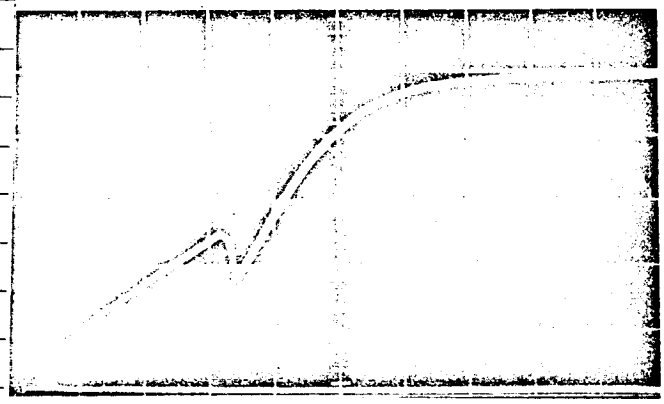
(OPENING TIME)

Horizontal = 5 ms/cm

Vertical = 10 mv/cm

Requirement = 0.021 sec/max

Actual = 0.0175 sec



VOLTAGE TRACE

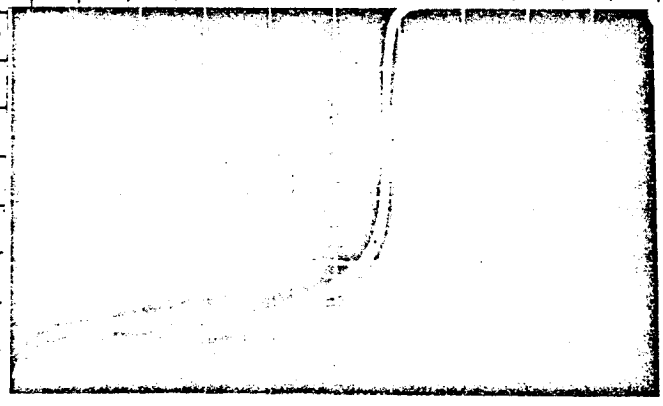
(CLOSING TIME)

Horizontal = 20 ms/cm

Vertical = 200mv/cm

Requirement = 0.075 sec/max

Actual = 0.064 sec



DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION TEST NO. 207510-401 SHEET 61 OF 171

7.1.2.2.3.14 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.021 maximum)	.0165 seconds	.017 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	.068 seconds	.064 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	11.8 VDC	12.3 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.7 VDC	~~1.8~~ 1.9 VDC *

Inspection Remarks

* WRITTEN IN ERRO.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams EA	7-10-64 4/15/64	J.S. Pope	10-3-64	L. Johnson	10-3-64	WAIVED BY J. MAVROGENIS	10-3-64
						VERIFIED BY USAF	10/6/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO 207510-401 SHEET ___ OF ___

IL 4388-5407

Deviation Request:

It is hereby authorized to inspect the TCA (paragraph 7.1.3.1.2) after completing the Shock Test for a whole axis. (Both positive and negative directions.)

Recopied from original request dated 13, October 1964.

James D. Mavrogenis
MAC Engineering
12-3-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO 207510-401 SHEET ___ OF ___

IL 4388-5408

Deviation Request:

Due to interference with the McDonnell bracket, inspect as many welds as possible when performing paragraph 6.2.

Recopied from original request dated 14, October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

R Cole
R. Cole
Gemini DAT-RAT Unit

12-3-64

FORM 608-B-37 NEW 6-63

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510-401 SHEET 62 OF 171

Reference:	MAC SCD 52-52701, Revision F, Paragraph 6.2.3.16
7.1.3	Shock - TCA #1
7.1.3.1	Test Procedure
7.1.3.1.1	Place the TCA into shipping container in accordance with RA0616-008 and install into the Shock Testing Facility. The direction of shock input shall be along the + X Axis of the TCA (see Figure 7).
7.1.3.1.2	Apply a half sine wave shock of 15 $^{+1.5}_{-0}$ g magnitude and 11 $\pm$1.0 milliseconds duration to the TCA. The shock magnitude and duration shall be monitored by an oscilloscope and the trace recorded with a Polaroid camera. Inspect the TCA for visible evidence of damage following the application of the shock. In the event of a structural failure, see paragraph 3.6.
7.1.3.1.3	Repeat paragraph 7.1.3.1.2 two times for a total of three shocks.
7.1.3.1.4	Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.3 for the -X Axis of the TCA.
7.1.3.1.5	Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.4 for the Y Axis of the TCA.
7.1.3.1.6	Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.4 for the Z Axis of the TCA.
7.1.3.1.7	Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.
7.1.3.1.8	Perform Thrust Chamber Proof Pressure and Leakage per paragraph 6.2.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	4/15/64	R. V. Erickson	4-18-64		
CHECKED BY:	DATE				
H. Cobb	4/17				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510-401 SHEET 63 OF 171

7.1.3.1.9	Perform Propellant Valve Electrical Resistance per paragraph 6.3.
7.1.3.1.10	Perform Propellant Valve Dielectric Strength per paragraph 6.4.
7.1.3.1.11	Perform Propellant Valve Functional per paragraph 6.5.
7.1.3.1.12	Perform Visual Inspection.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	4/15/64	R.J. Eide	4-18-64		
CHECKED BY:	DATE				
	4/17				

FORM 608-B-38 NEW 6-63

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Page 1 of 6
Lab Test No. TK20-17-26

Prepared by	EWR No.	Facility	Date
V DAVIS	5FS 5EC	C.ANC	10-14-64
Part	**Part No.**	**Serial No.**	
85# TCA	207510-21	4051207	

Metering Pin Data

Hyge Unit 6401
Acceleration 15.5's ± 1.5 G's
Acc. Waveshape HALF-SINE
Acc. Time 11 m SEC ± 1 m SEC

Accelerated Mass

a. Specimen and fixture 70. lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 170. lbs.

Hydraulic Fluid Level

a. 50. cc ~~inches~~ as measured down from top of top cylinder.
b. _____

Operational Data

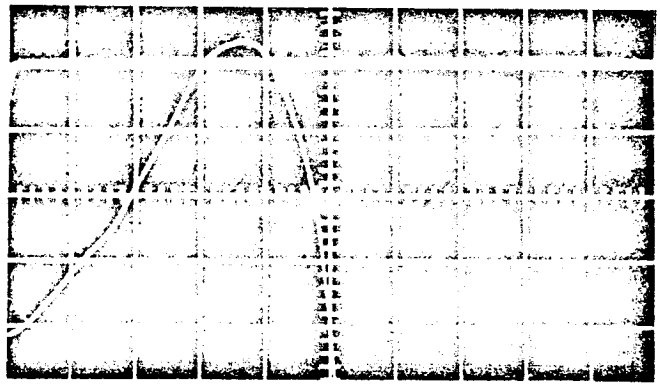
Set Pressure 15. psig
Firing Pressure _____ psig
Brake Pressure _____ psig
Accumulator Pressure _____ psig
(Alternate Firing)

Deceleration Orifice Position

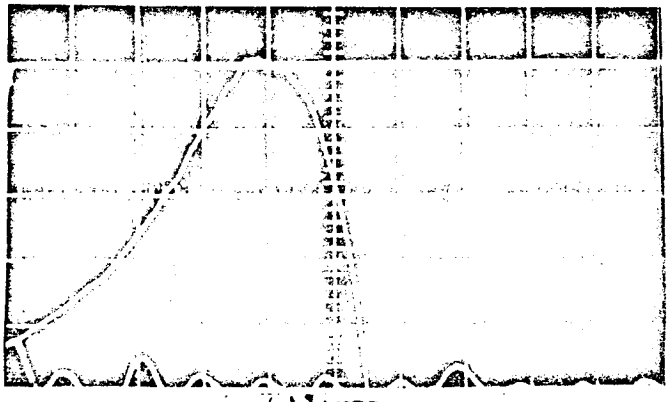
a. _____ Contour side up
b. ✓ Contour side down

Calibration

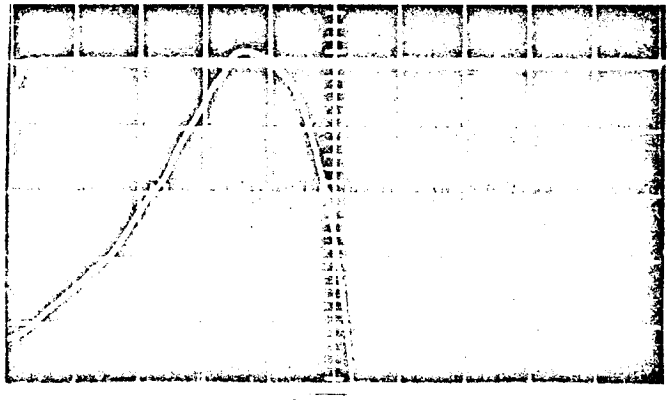
Vertical (G's/square) _____
Horizontal (MS/square) _____
Accelerometer _____



+X AXIS



+X AXIS



+X AXIS

Remarks: NO VISIBLE DAMAGE

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-12-26

Prepared by	EWR No.	Facility	Date
V. DAVIS	585586	CANOGA	12-14-64
Part	**Part No.**	**Serial No.**	
85# T.C.A	207510-21	4051207	

Metering Pin Data

Hyge Unit 6401
Acceleration 15G ± 1.5G's
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC ± 1 M.SEC

Accelerated Mass

a. Specimen and fixture 40 lbs.
b. Carriage 80.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 170 lbs.

Hydraulic Fluid Level

a. 50 ~~Inches~~ cc as measured down from top of top cylinder.
b. _____

Operational Data

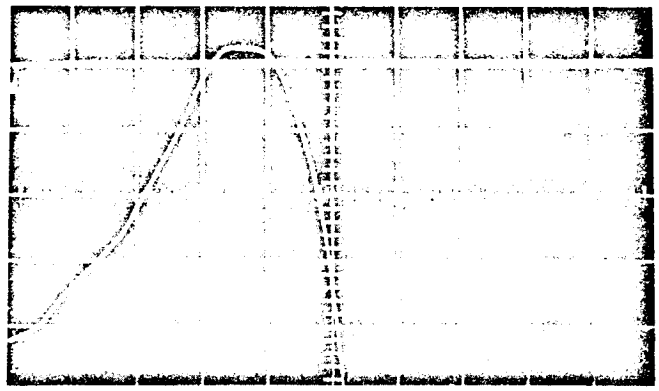
Set Pressure 15 psig
Firing Pressure ~~4~~ 5 psig
Brake Pressure 125 psig
Accumulator Pressure _____ psig
(Alternate Firing)

Deceleration Orifice Position

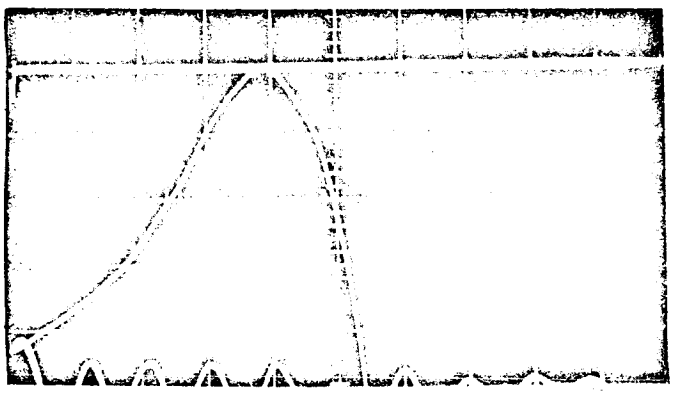
a. _____ Contour side up
b. ✓ Contour side down

Calibration

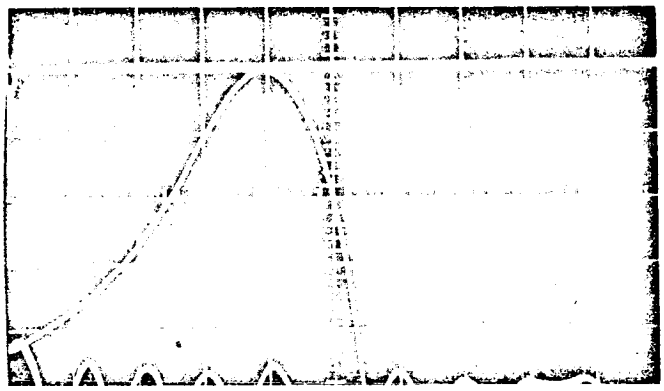
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer SN 2030
Statham ASIC-50-350



—X AXIS



—X AXIS



—Y AXIS

Remarks: NO VISIBLE DAMAGE

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. [illegible]-17-26

Prepared by	EWR No.	Facility	Date
V. DAVIS	595586	E&AC	10-14-64
Part	**Part No.**	**Serial No.**	
85# T.C.A.	207510-21	4051267	

Metering Pin Data

Hyge Unit 6401
Acceleration 150 ± 1.5 G's
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC ± 1M.SEC

Hydraulic Fluid Level

a. 50 ~~inches~~ CC as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. C Contour side down

Calibration

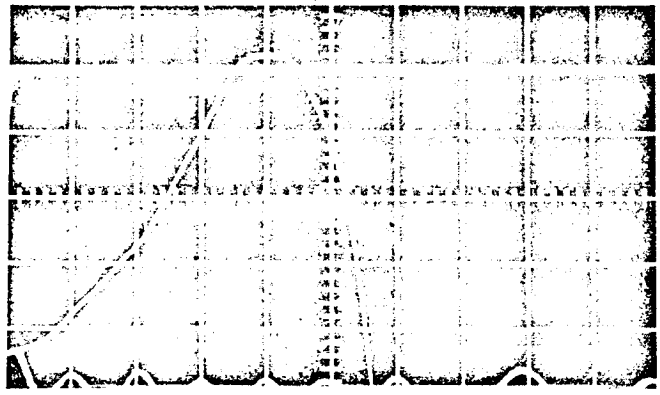
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer SN 7030
STATHAM A-5TC-50-350

Accelerated Mass

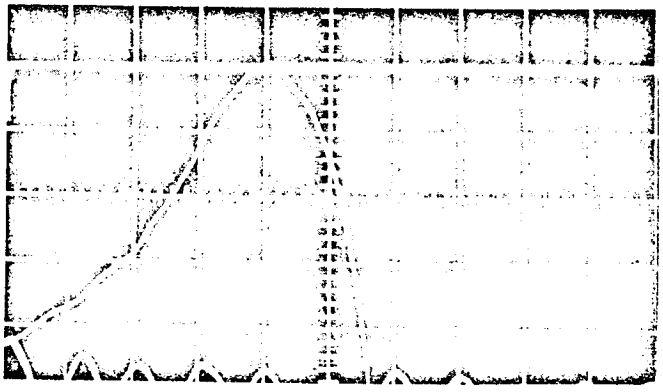
a.	Specimen and fixture	40. lbs.
b.	Carriage	30.0 lbs.
c.	Internal Hyge	50.0 lbs.
	Total	120. lbs.

Operational Data

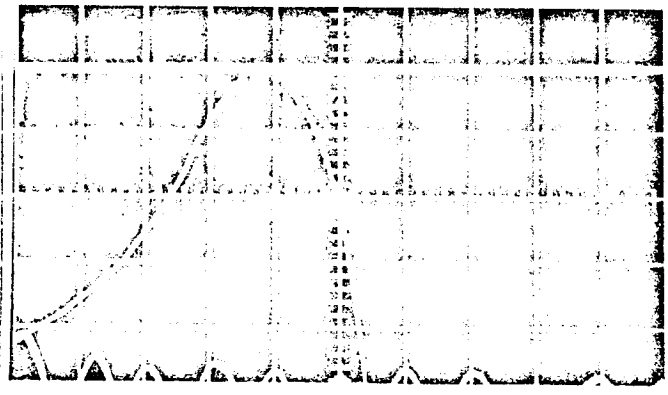
Set Pressure	15 psig
Firing Pressure	400 psig
Brake Pressure	125 psig
Accumulator Pressure (Alternate Firing)	psig



+Y AXIS



+ Y AXIS



+Y AXIS

Remarks: NO VISIBLE DAMAGE

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K20-17-26

Prepared by	EWR No.	Facility	Date
V DAVIS	585586	CANO	10-14-64
Part	**Part No.**	**Serial No.**	
85# TCA	207510-21	4051207	

Metering Pin Data

Hyge Unit 6401
Acceleration 15G+1.5G'S
Acc. Waveshape HALF-SINE
Acc. Time 11M.SEC ± 1M.SEC

Accelerated Mass

a. Specimen and fixture 40.0 lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 170.0 lbs.

Hydraulic Fluid Level

a. 50 cc inches as measured down from top of top cylinder.
b.

Operational Data

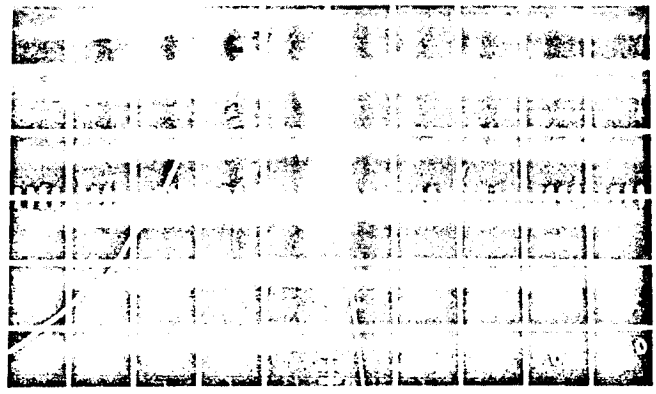
Set Pressure 15 psig
Firing Pressure 400 psig
Brake Pressure 125 psig
Accumulator Pressure psig
(Alternate Firing)

Deceleration Orifice Position

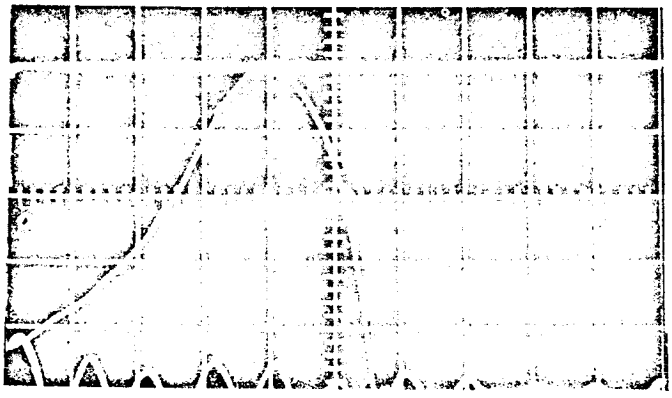
a. Contour side up
b. ✓ Contour side down

Calibration

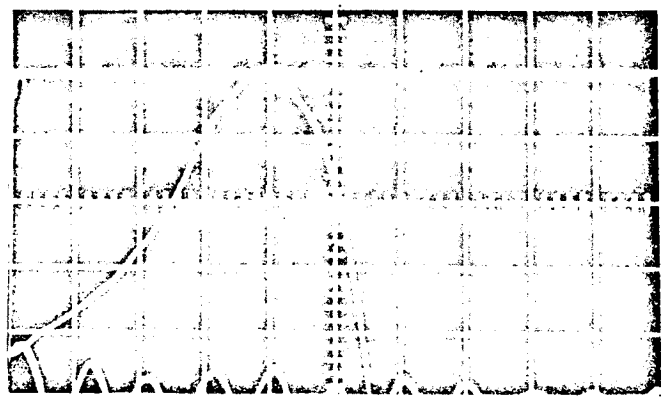
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer S/N 7030
STATHAMASTC-50-350



−Y AXIS



−Y AXIS



−Y AXIS

Remarks: NO VISIBLE DAMAGE

R-15019-2

Form 600-V-69 Now 3-64

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K-20-17-26

Prepared by	EWR No.	Facility	Date
V. DAVIS	585586	CANO.	10-14-64
Part	**Part No.**	**Serial No.**	
85# TCA	207510-21	405207	

Metering Pin Data

Hyge Unit 6KC1
Acceleration 15G ± 1.5 G's
Acc. Waveshape HALF-SINE
Acc. Time 11 M.SEC ± 1M.SEC.

Hydraulic Fluid Level

a. 50 cc ~~inches~~ as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

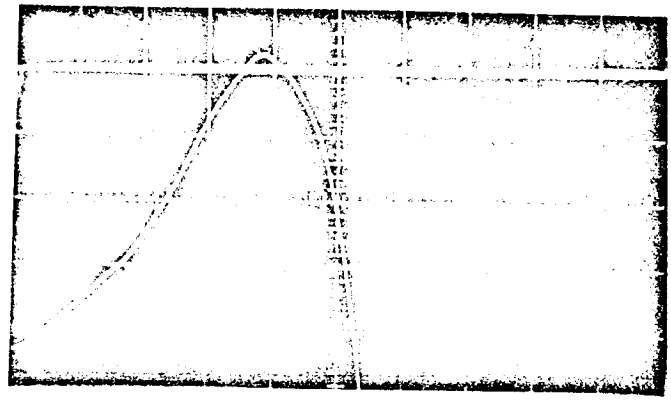
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer S/N 2030
STATHAMASTER-5-0-350

Accelerated Mass

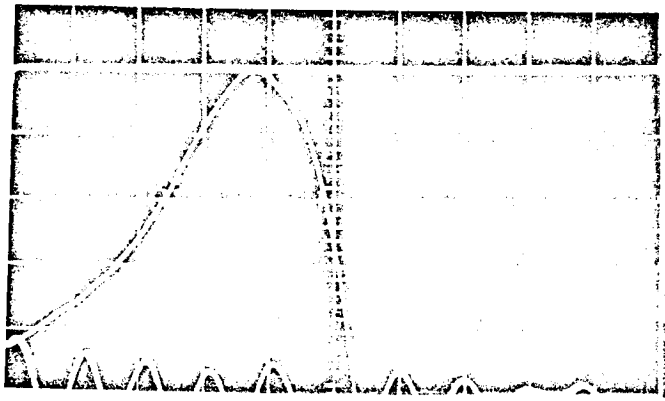
a. Specimen and fixture 40. lbs.
b. Carriage 30.0 lbs.
c. Internal Hyge 50.0 lbs.
Total 120.0 lbs.

Operational Data

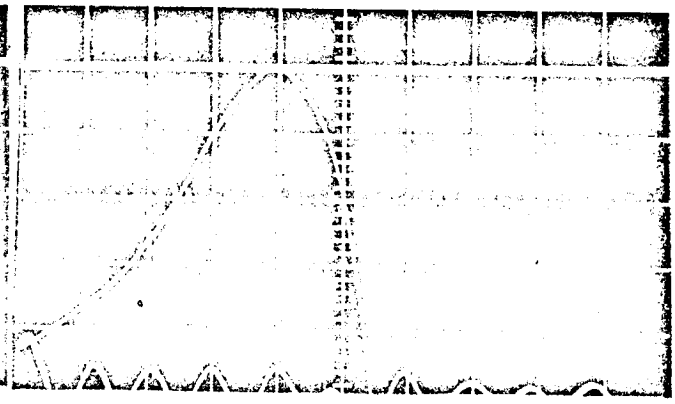
Set Pressure 15 psig
Firing Pressure 400 psig
Brake Pressure 125 psig
Accumulator Pressure _____ psig
(Alternate Firing)



+ Z AXIS



+ Z AXIS



+ Z AXIS

Remarks: NO VISIBLE DAMAGE

ROCKETDYNE DEVELOPMENT LABORATORY
SHOCK TEST DATA SHEET

Lab Test No. 4K-20-17-26

Prepared by	EWR No.	Facility	Date
V DAVIS	585586	CANO	10-14-64
Part	**Part No.**	**Serial No.**	
85# T.C.A.	207510-21	405207	

Metering Pin Data

Hyge Unit 6401
Acceleration 1.5G + 1.5 G'S
Acc. Waveshape HALF-SINE
Acc. Time 11M.SEC. ± 1M.SEC.

Hydraulic Fluid Level

a. 50 cc ~~inches~~ as measured down from top of top cylinder.
b. _____

Deceleration Orifice Position

a. _____ Contour side up
b. ✓ Contour side down

Calibration

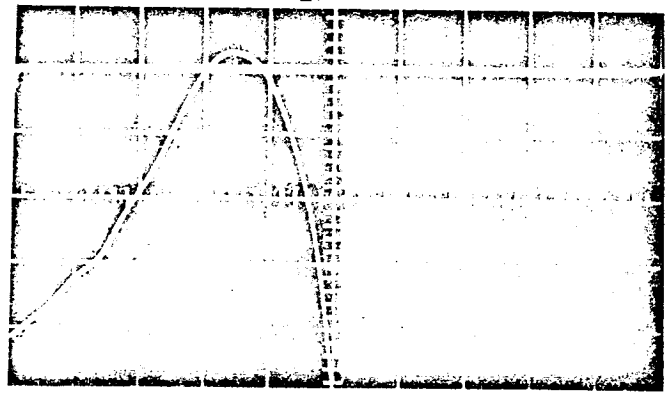
Vertical (G's/square) 3
Horizontal (MS/square) 2
Accelerometer S/N 7030
STATHAMASTE-50-350

Accelerated Mass

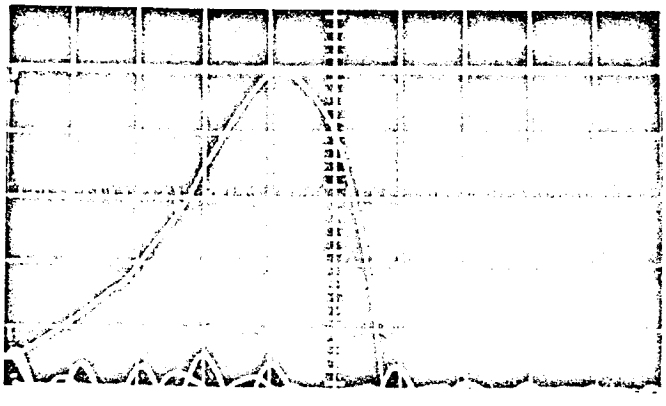
a.	Specimen and fixture	40.0 lbs.
b.	Carriage	30.0 lbs.
c.	Internal Hyge	50.0 lbs.
	Total	120.0 lbs.

Operational Data

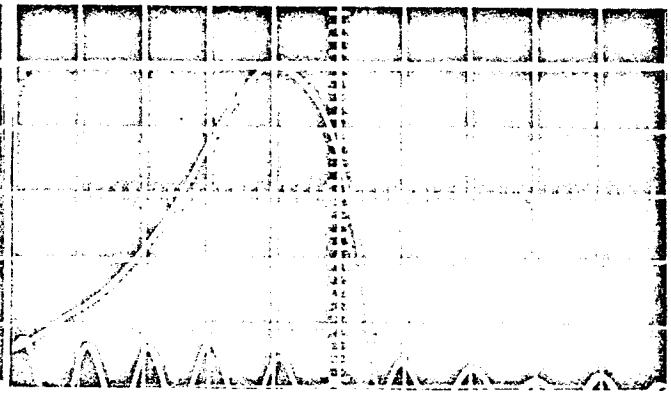
Set Pressure	1.5	psig
Firing Pressure	400	psig
Brake Pressure	125	psig
Accumulator Pressure (Alternate Firing)		psig



-Z AXIS



-Z AXIS



-Z AXIS

Remarks: NO VISIBLE DAMAGE

R-15019-2

Form 600-V-69 New 3-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510-401 SHEET 64 OF 171

7.1.3.2 Test Data - TCA #1

7.1.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 40-1207

7.1.3.2.2 Shock Test (reference paragraph 7.1.3.1)

Magnitude 15 $^{+1.5}_{-0}$ g's	Duration 11 $\pm$1.0 milliseconds
+ X Axis	
16.2	11.0
15.4	11.0
15.6	11.2
- X Axis	
15.8	10.5
15.0	11.0
15.0	11.0

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams EA 4/15/64	Clarence Kudzia 10-13-64	10-13-64	WAIVED BY J. HARLAN 10-13-64
			VERIFIED BY USAF DATE 13 OCT 64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510 SHEET 65 OF 171

7.1.3.2.2 (cont'd) Shock Test (reference paragraph 7.1.3.1)

Magnitude 15 $^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds	Magnitude 15 $^{+1.5}_{-0}$ g's	Duration 11 ±1.0 milliseconds
+Y Axis		+Z Axis	
15.6	11.0	15.6	11.0
15.2	11.0	15.0	11.0
15.1	11.0	15.0	11.0
-Y Axis		-Z Axis	
15.6	11.0	15.9	10.0
15.2	11.0	15.0	11.0
15.2	11.0	15.0	11.0

Inspection Remarks

NONE 10-13-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	Clarence Kudzia 10-13-64	A. Kaye 10-13-64	WAIVED BY NAVROGENS 10-13-64
			VERIFIED BY USAF / DATE 10/13/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO 207510-401 SHEET 66 OF 171

7.1.3.2.3 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	ZERO scc He/min	ZERO scc He/min

Inspection Remarks

NONE 10-14-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	7-10-64	F. E. Pope	10-14-64	W. Tarpley	10-14-64	WAIVED BY J. HARRIGEAIS	10-14-64
						VERIFIED BY USAF	DATE
						R. Turner	10/14/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO 207510-401 SHEET 67 OF 171

7.1.3.2.4 Thrust Chamber Proof Pressure and Leakage Test (reference paragraph 6.2)

Proof Pressure

	1st Application	2nd Application
Pressure (392 ±10)	392 psig	392 psig
Time Duration (3 +0.25 −0)	3 minutes	3 minutes
Voltage (12± 2)	12 VDC	12 VDC

REF IL DTD 10-14-64 D.W.O.K. 10-14-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNEL / DATE
E. Adams 4/15/64 7-10-64	F. E Boge 10-14-64	N. Kaye 10-14-64	WAIVED BY T. HAUROGEANS 10-14-64
			VERIFIED BY USAF / DATE: Richard Dorman 10/14/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510-401 SHEET 68 OF 171

7.1.3.2.5 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 40.61 ohms (Acceptable per Figure 10; yes or no YES)

Fuel Valve 41.61 ohms (Acceptable per Figure 10, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .06 ohms

Fuel Valve .07 ohms

Inspection Remarks

NONE 10-14-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	H. I. Pope 10-14-64	D. Kaye 10-14-64	WAIVED BY J. MAVROGENIS 10-14-64
			VERIFIED BY USAF / DATE 10/14/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510-401 SHEET 69 OF 171

7.1.3.2.6 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500 (ANR 224)	70 (ANR 224)	500 (ANR 224)	68
C to Ground	500 (ANR 224)	45 (ANR 224)	500 (ANR 224)	45
A to C	500 (ANR 224)	15 (ANR 224)	500 (ANR 224)	13

Inspection Remarks

None 10-15-64 (ANR 224)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	J. T. Pope 10-14-64	J. Kaye (ANR 224) 10-14-64	WAIVED BY J. KAVROGIANS 10-14-64 (ANR 224)
			VERIFIED BY USAF / DATE: R. McNamara 10/14/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L.Cracraft	585586	ENV.LAB	2061	10-14-64
PART	**PART NO.**	**TYPE OF TEST**		
85# OAMS TCA UNIT #1	207510-21 S/N 4051207	POST SHOCK FUNCTIONAL		

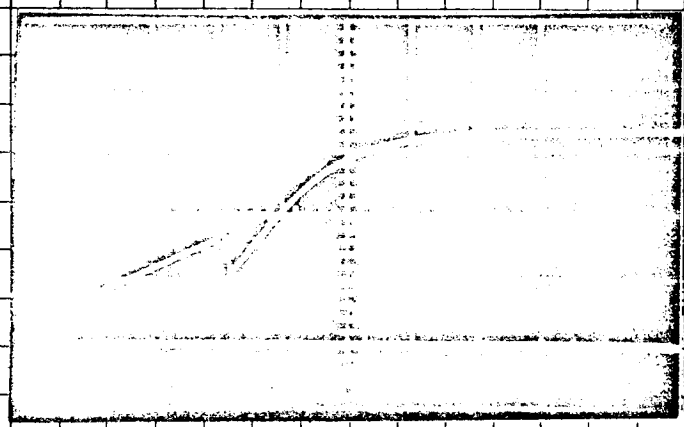
OXIDIZER VALVE

P/N 407561 S/N 4057605

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 20 mv/cm

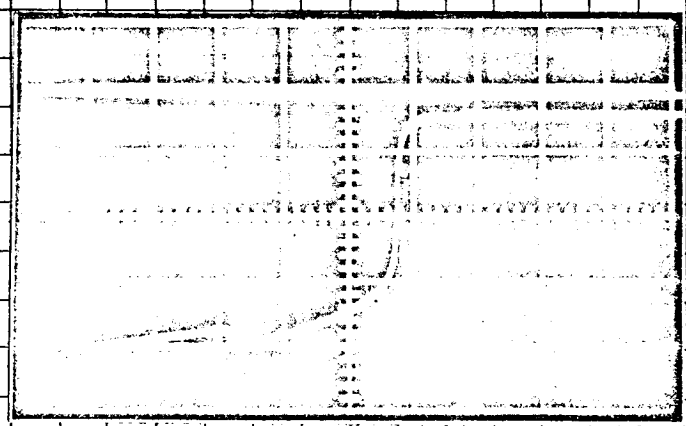
Requirement = 0.021 sec/max
Actual = 0.016 sec



VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.065 sec



Form 600-W-67 New 10-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

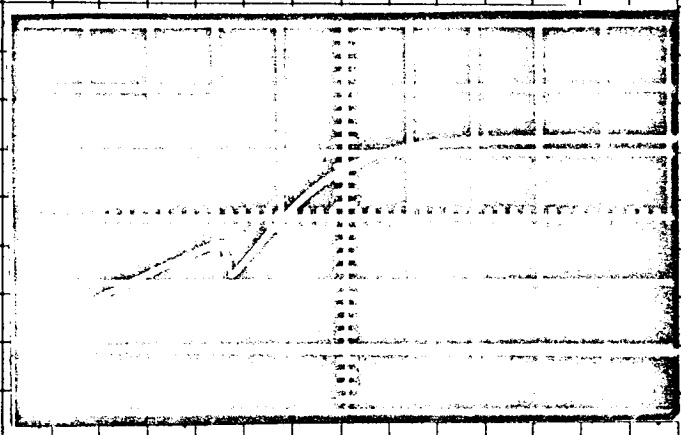
LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L.Cracraft	585586	ENV.LAB	2061	10-14-64
PART	**PART NO.**	**TYPE OF TEST**		
85# OAMS TCA UNIT #1	S/N 4051207	POST SHOCK FUNCTIONAL		

FUEL VALVE

P/N 407662 S/N 4057623

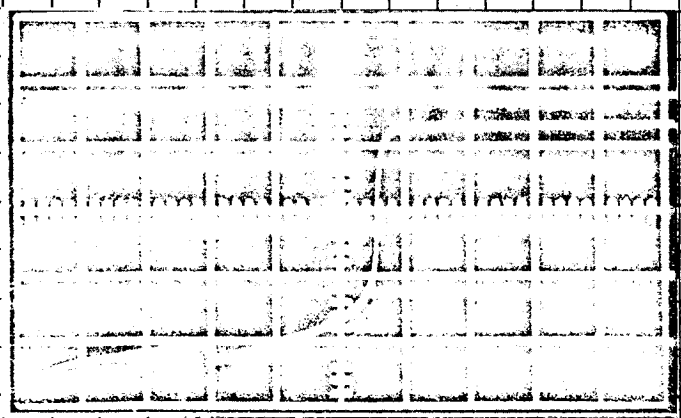
CURRENT TRACE
(OPENING TIME)



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.016 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.060 sec

2.5

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21-401

NAME OF TEST MECHANICAL SHOCK TEST NO. 207510 SHEET 70 OF 171

7.1.3.2.7 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F (ANR 224)	70 F (ANR 224)
Energizing Voltage (26 ±0.5)	26 VDC (ANR 224)	26 VDC (ANR 224)
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 224)	300 psig (ANR 224)
Opening Time (0.021 maximum)	0.016 seconds (ANR 224)	0.016 seconds (ANR 224)
Inlet Pressure (zero for "drop-out")	ZERO psig (ANR 224)	ZERO psig (ANR 224)
Closing Time (0.075 maximum)	0.065 seconds (ANR 224)	0.060 seconds (ANR 224)
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F (ANR 224)	70 F (ANR 224)
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 224)	300 psig (ANR 224)
Opening Voltage (16 maximum)	11.6 VDC (ANR 224)	11.7 VDC (ANR 224)
Inlet Pressure (zero for "drop-out")	ZERO psig (ANR 224)	ZERO psig (ANR 224)
Closing Voltage (1.0 minimum)	1.45 VDC (ANR 224)	1.60 VDC (ANR 224)

Inspection Remarks

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	L. L. Crandall 10-14-64	K. Kaye (ANR 224) 10-14-64	MAILED BY (ANR 224) J. MAURER 10-14-64
7-10-64			VERIFIED BY USAF / DATE 14 OCT 64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 71 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.7

7.1.4 Temperature Shock - TCA #1

7.1.4.1 Test Procedure

7.1.4.1.1 Place the TCA unit in a tmeperature chamber maintained at a temperature of 185 ±5F.

7.1.4.1.2 Expose the TCA to 185 ±5F for a continous period of four hours minimum.

7.1.4.1.3 Transfer the TCA unit to a temperature chamber maintained at a temperature of -40 ±5F..

NOTE: Throughout the temperature shock testing the transfer of the TCA from one temperature chamber to another shall be accomplished within a maximum time limit of five minutes.

7.1.4.1.4 Expose the TCA unit to -40 ±5F for a continuous period of four hours minimum.

7.1.4.1.5 Repeat paragraphs 7.1.4.1.1 through 7.1.4.1.4 two more times.

7.1.4.1.6 Allow the TCA unit to return to room ambient temperature.

7.1.4.1.7 Within one hour, following stabilization of the TCA's temperature, begin the first of the following procedures. The tests shall be carried through to completion without delay. In the event of a structural failure, see paragraph 3.6.

7.1.4.1.7.1 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

7.1.4.1.7.2 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.

PREPARED BY: E. Adams EA	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [illegible]	DATE 4/17	[illegible] 4-18-64			

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 72 OF 171

7.1.4.1.7.3 Perform propellant Valve Electrical Resistance Test per paragraph 6.3.

7.1.4.1.7.4 Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.

7.1.4.1.7.5 Perform Propellant Valve Functional Test per paragraph 6.5.

PREPARED BY: E. Adams EA DATE 4/15/64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: DATE 4/17		

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 73 OF 171

7.1.4.2 Test Data - TCA #1

7.1.4.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 4051207

7.1.4.2.2 Temperature Shock Test (reference paragraph 7.1.4.1)

7.1.4.2.2.1 The TCA was placed in a temperature chamber where it was exposed to a temperature of 186 F (185 ±5F) for a time period of 4 (4 minimum) hours.

7.1.4.2.2.2. The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.1.4.2.2.3 The TCA was transfered to a temperature chamber where it was exposed to a temperature of 185 F (185 ±5F) for a time period of 4.04 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.1.4.2.2.4 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	4/15/64						
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 74 OF 171

7.1.4.2.2.5 The TCA was transfered to a temperature chamber where it was exposed to a temperature of 185 F (185 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (yes or No)

7.1.4.2.2.6 The TCA was transfered to a temperature chamber where it was exposed to a temperature of -40 F (-40 ±5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)

7.1.4.2.2.7 Inspection Remarks

NONE 10-16-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	F. E. Pope 10-16-64	E. Kaye 10-16-64	WAIVED BY J HAVRONEWIS 10-16-64
			VERIFIED BY USAF / DATE: R L Mannes 10/16/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 75 OF 171

7.1.4.2.3 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Proof Pressure	Oxidizer Valve	Fuel Valve
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	* ~~ZERO~~ < 0.1 scc He min	< 0.1 scc He min

Inspection Remarks

NOTE 10-16-64

* ENTERED IN ERROR

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	F. E. Pope 10-16-64	V Kayle 10-16-64	WAIVED BY J. MAVROGENIS 10-16-64
			VERIFIED BY USAF / DATE: R.F. McDonnell 10/16/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 76 OF 171

7.1.4.2.4 Thrust Chamber Proof Pressure and Leakage Test (reference paragraph 6.2)

Proof Pressure

	1st Application	2nd Application
Pressure (392 ±10)	392 psig	392 psig
Time Duration (3 +0 -0.25)	3 minutes	3 minutes
Voltage (12±2)	12 VDC	12 VDC

NONE 10-16-64 REF 16 DTD 10-14-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	F. S. Pope 10-16-64	D Kayle 10-16-64	WAIVED BY T. MAVROGENIS
			VERIFIED BY USAF / DATE RLMcNamee 10/16/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 77 OF 171

7.1.4.2.5 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance	A - B	
Oxidizer Valve	41.32 ohms	(Acceptable per Figure 10, yes or no YES)
Fuel Valve	41.82 ohms	(Acceptable per Figure 10, yes or no YES).
Resistance	C - D (1.0 maximum)	
Oxidizer Valve	.05 ohms	
Fuel Valve	.09 ohms	

Inspection Remarks

NONE 10-16-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	F. E. Pope 10-16-64	N. Kaye 10-16-64	WAIVED BY J. KANROBBINS 10-16-64
			VERIFIED BY USAF / DATE R.W. Howe 10/16/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-275 / NAA 207510-21-401

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510 SHEET 78 OF 171

7.1.4.2.6 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 −0	Current Microamps 500 max.	Voltage Volts 500 +10 −0	Current Microamps 500 max.
A to Ground	500	75	500	74
C to Ground	500	59	500	50
A to C	500	16	500	16

Inspection Remarks

NONE 10-16-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNEL / DATE
E. Adams EA 4/15/64	F. E. Page 10-16-64	F. Kaye 10-16-64	WAIVED BY J. MONROGENIS 10-16-64
			VERIFIED BY USAF / DATE: [illegible] 10/16/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

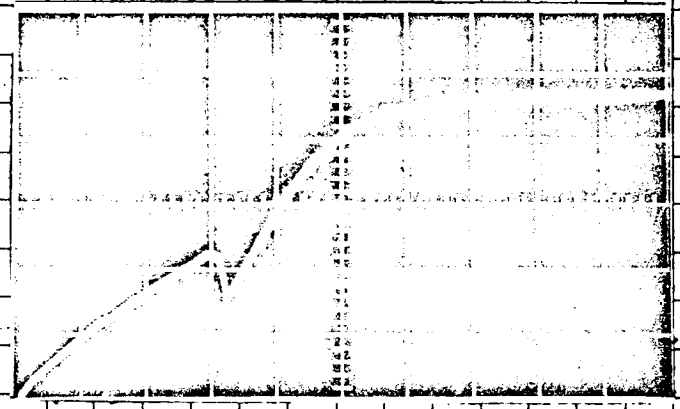
PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F. Pope	585586	ENV.LAB.	2061	10-20-64

PART	PART NO	TYPE OF TEST
85# OAMS TCA UNIT #1	207510-21 S/N 4051207	POST TEMPERATURE SHOCK FUNCTIONAL

OXIDIZER VALVE

P/N 407561 S/N 4057605

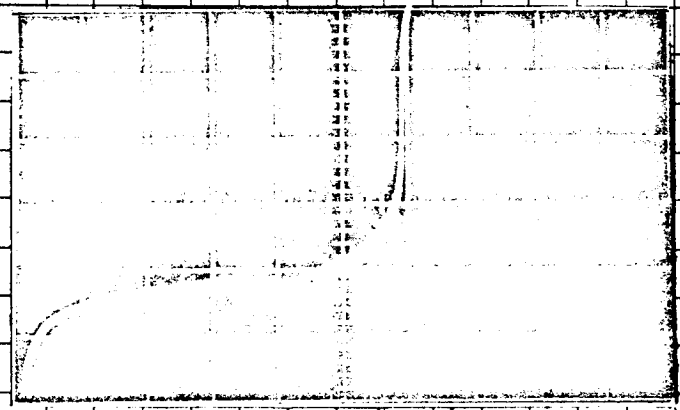
CURRENT TRACE
(OPENING TIME



Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.021 sec/max
Actual = 0.016 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.068 sec

R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV.LAB	2061	10-2064

PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #1	207510-21 S/N 4051207	POST TEMPERATURE SHOCK FUNCTIONAL

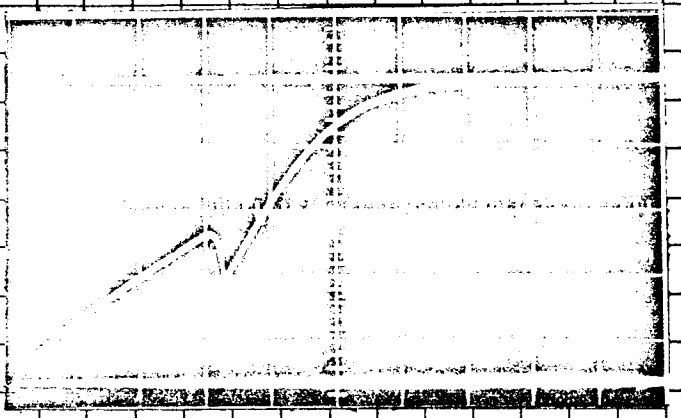
FUEL VALVE

P/N 407662 S/N 4057623

CURRENT TRACE
(OPENING TIME)

Horizontal = 5 ms/cm
Vertical = 20 mv/cm

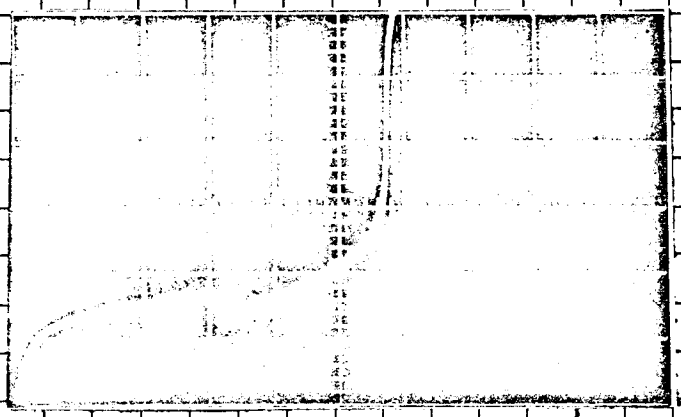
Requirement = 0.021 sec/max
Actual = 0.0165 Sec



VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 20ms/cm
Vertical = 200mv/cm

Requirement = 0.075 sec/max
Actual = 0.063 sec



DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST TEMPERATURE SHOCK TEST NO. 207510-401 SHEET 79 OF 171

7.1.4.2.7 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.021 maximum)	0.016 seconds	0.0165 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	0.068 seconds	0.063 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	11.9 VDC	11.8 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.40 VDC	1.56 VDC

Inspection Remarks

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	F. E. Pope 10-16-64	D. Kaye 10-16-64	WAIVED BY T MARVAGENIS 10-16-64
			VERIFIED BY USAF / DATE R M Mauler 10/16/4

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207510-401 SHEET 80 OF 171

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.2.2

7.1.5 DAT Duty Cycle to Guaranteed Life - TCA #1

7.1.5.1 Test Procedure

7.1.5.1.1 Perform Cape Cycle Firing Test per paragraph 6.7.

7.1.5.1.1.1 Make a one second firing followed by another one second firing five minutes later.

7.1.5.1.1.2 Wait ten minutes and make a one second firing followed by another one second firing five minutes later.

7.1.5.1.1.3 Repeat paragraph 7.1.5.1.1.2.

7.1.5.1.2 Wait for the TCA core temperature to return to ambient temperature (70 ±20F) and perform the DAT Duty Cycle Firing Test of paragraph 6.7 and Table II. The TCA shall be fired until catastrophic failure. Catastrophic failure is defined in Table II, Note 4.

7.1.5.1.2.1 The TCA shall not exceed a maximum skin temperature of 500 F at the end of the 147 seconds total burn time ("In Spec" Performance).

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	10-9-64				
CHECKED BY:	DATE				
	12-24-64		12-24-64		

FORM 668-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207510-401 SHEET 80.1 OF 171

7.1.5.1.2.2 The TCA shall not exceed a maximum skin temperature of 700F at 270 seconds total burn time. (guaranteed life).

7.1.5.1.3 Perform decontamination per paragraph 6.8.

7.1.5.1.4 Reduce data per RA0220-231.

7.1.5.1.4.1 The results of significant data shall include but not be limited to the following:

7.1.5.1.4.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations.

7.1.5.1.4.1.2 Graphical presentation of thrust versus time.

7.1.5.1.4.1.3 Graphical presentation of chamber pressure versus time.

7.1.5.1.4.1.4 Graphical presentation of oxidizer flowrate versus time.

7.1.5.1.4.1.5 Graphical presentation of fuel flowrate versus time.

7.1.5.1.5 Perform weight determination per paragraph 6.6.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	9-16-64		10-14-64		
CHECKED BY:	DATE				
	10-26-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207510-401 SHEET 81 OF 171

7.1.5.2 Test Data - TCA #1

7.1.5.2.1 Component Identification

Component Name 85# SL 1 TCA

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 205227

Accumulated Acceptance Test Firing Time, seconds 60 sec.

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	.672	[illegible]
Nozzle Exit Diameter, inches	4.213	4.210

7.1.5.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	4/13/64	[illegible]
Sample Batch Number	10 297	[illegible]
Sample Temperature, F	66	77
Sample Specific Gravity	1.441	0.871
Met Mil Spec. Requirements (No / Yes)	Yes	Yes

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 4/15/64	[signature] 10-24-64	[signature] 10/24/64	WAIVED BY MAC [illegible] 10-24-64
			VERIFIED BY USAF DATE
			Waived 10/24/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207510-401 SHEET ___ OF ___

IL 5388-6249

Deviation Request:

It is hereby authorized to accept the following deviations from the DAT Specification 207510-401 for 85# TCA Unit #1.

1. The Cape Cycle pulse duration (1.05 second) exceeded the specification limit of 1.00 ±.02 seconds.

2. The MDC pulse "Start Time" (TCA start signal to 90 percent thrust) cannot be established for pulse numbers 1, 2 and 6: the data for pulse number 1 indicates a thrust above 90 percent of the steady state level prior to the maximum start time value, however the thrust trace for pulses 2 and 6 are unreducible at the beginning of each pulse. The thrust trace for pulse number 8 was satisfactory for an accurate reduction of the start time.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
1-22-65

John A. Ganger
John A. Ganger
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DUTY CYCLE TO FAILURE TEST NO. 207510-401 SHEET 81 OF 171

7.1.5.2.3 Cape Cycle Test (reference paragraph 7.1.5.1)

Test Cell Location [illegible]

Test Cell Number 41K

Test Number C41

Test Date 10-24-64

	Pulse Duration (sec) (1.000 ±.020 sec)	Time between Pulses, (minutes)
1st Pulse	1.05	5 (5)
2nd Pulse	1.05	10 (10)
3rd Pulse	1.05	5 (5)
4th Pulse	1.05	10 (10)
5th Pulse	1.05	5 (5)
6th Pulse	1.05	

Accumulated Firing Time, seconds 6.3

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9-3-64	J.H. Berger 10-24-64	D.J. Berg 10/24/64 (ANR 930)	APPROVED BY MAC ENGR. L.A. Boogren 10-24-64
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207510-401 SHEET 81 OF 171

7.1.5.2.4 Duty Cycle Test (reference paragraph 7.1.5.1)

Test Cell Location 57K

Test Cell Number [illegible]

Test Number 092

Test Date 11-24-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
J. Ganger 9/17/64	[signature] 10.24.64	[signature] 10/24/64	WAIVED BY MAC [signature] 11/16-365 10-24-64
			VERIFIED BY USAF / DATE [signature] 10/24/64

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 2075 10-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 2075 10-401 SHEET 82 OF 171

7.1.5.2.4.1 Pluse No. 1-111 seconds on-time followed by 160 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	112.2		
Accumulated Firing Time, sec	1260		
Data Slice Number	2		
Time of Data Slice	110		
Ambient Pressure, in. Hg	27.99		
Ambient Temperature, F	67.0		
Environmental Pressure, psia	.015	0	
Environmental Temperature, F	155		
Oxidizer Temperature, F	70.0	70.00	
Fuel Temperature, F	67.0	70.00	
Oxidizer Inlet Pressure, psia	279.7	285.00	
Fuel Inlet Pressure, psia	286.7	287.00	
Chamber Pressure, psia	132.6	131.6	
Oxidizer Flowrate, lbs/sec	.1656	.1676	
Fuel Flowrate, lbs/sec	.1031	.1028	
Mixture Ratio, O/F	1.61	1.63	1.60 ±0.09
Main Thrust, lbs.	78.5	79.3	79.0 ±4.0
Specific Impulse, sec.	292	293	(280) min.
Electrical Power, Watts	45.9		
Oxidizer Valve Voltage, Volts	30.3		
Fuel Valve Voltage, Volts	30.56		
Oxidizer Valve Current, Amps	.771		
Fuel Valve Current, Amps.	.737	Reached 40% within Limit	
Start Time, Millisec.			50 max.
Shutdown Time, Millisec.	96		125 max.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	9/17/64	M. Robinson	1-13-65			[illegible]	
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

R-15019-2

~~GROUP-4~~
~~Downgraded at 3 year intervals;~~
~~Declassified after 12 years~~

~~CONFIDENTIAL~~

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794, ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 8511 PART NO. {MAC 52-52701-275 / NAA 2075 10-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 2075 10-401 SHEET 83 OF 171

7.1.5.2.4.2 Pluse No. 2- 10 seconds on-time followed by 1.0 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	10.1		
Accumulated Firing Time, sec	137.2		
Data Slice Number	1		
Time of Data Slice	9.0		
Ambient Pressure, in. Hg	29.29		
Ambient Temperature, F	62.0		
Environmental Pressure, psia	.015	0	
Environmental Temperature, F	123		
Oxidizer Temperature, F	70.0	70.00	
Fuel Temperature, F	67.0	70.00	
Oxidizer Inlet Pressure, psia	279.2	285.00	
Fuel Inlet Pressure, psia	285.7	287.00	
Chamber Pressure, psia	121.8	122.9	
Oxidizer Flowrate, lbs/sec	.1610	.1691	
Fuel Flowrate, lbs/sec	.1039	.1040	
Mixture Ratio, O/F	1.61	1.63	1.60 ±0.09
Main Thrust, lbs.	81.0	81.9	79.0 ±4.0
Specific Impulse, sec.	299	300	(280) min.
Electrical Power, Watts	43.2		
Oxidizer Valve Voltage, Volts	30.1		
Fuel Valve Voltage, Volts	30.56		
Oxidizer Valve Current, Amps	.733	F Time Unreadable	
Fuel Valve Current, Amps.	.689		
Start Time, Millisec.		50 max.	
Shutdown Time, Millisec.	109	125 max.	

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9/17/64	1-13-65		1/13/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

R-15019-2

GROUP-4
Downgraded at 3 year intervals; declassified after 12 years

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THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

~~CONFIDENTIAL~~

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 2075 10-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 2075 10-401 SHEET 84 OF 171

7.1.5.2.4.3 Pluse No.6 followed by	seconds on-time 1.0 seconds off-time 1.0	Site Data	Standard Vacuum	
	Firing Duration, sec	60		
	Accumulated Firing Time, sec	1474		
	Data Slice Number	1		
	Time of Data Slice	.9		
	Ambient Pressure, in. Hg	27.99		
	Ambient Temperature, F	67.0		
	Environmental Pressure, psia	.015	0	
	Environmental Temperature, F	130		
	Oxidizer Temperature, F	70.0	70.00	
	Fuel Temperature, F	68.0	70.00	
	Oxidizer Inlet Pressure, psia	285.5	285.00	
	Fuel Inlet Pressure, psia	292.0	287.00	
	Chamber Pressure, psia	124.1	124.1	
	Oxidizer Flowrate, lbs/sec	.1660	.1657	
	Fuel Flowrate, lbs/sec	.1034	.1020	
	Mixture Ratio, O/F	1.61	1.62	1.60 ±0.09
	Main Thrust, lbs.	79.6	79.4	79.0 ±4.0
	Specific Impulse, sec.	296	297	(280) min.
	Electrical Power, Watts	43.0		
	Oxidizer Valve Voltage, Volts	30.5		
	Fuel Valve Voltage, Volts	30.7		
	Oxidizer Valve Current, Amps	.716		
	Fuel Valve Current, Amps.	.689	F Trace unreadable	
	Start Time, Millisec.			50 max.
	Shutdown Time, Millisec.	110		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9-16-64	(s) Robinson 1-13-65		James D. Harrington 1/13/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 2075101-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 2075101-401 SHEET 84.1 OF 171

7.1.5.2.4.4 Pluse No. 8 seconds on-time 0.5 followed by seconds off-time 0.5

	Site Data	Standard Vacuum	
Firing Duration, sec	.5		
Accumulated Firing Time, sec	148.4		
Data Slice Number	1		
Time of Data Slice	.4		
Ambient Pressure, in. Hg	27.99		
Ambient Temperature, F	67.0		
Environmental Pressure, psia	.015	0	
Environmental Temperature, F	133		
Oxidizer Temperature, F	70.0	70.00	
Fuel Temperature, F	68.0	70.00	
Oxidizer Inlet Pressure, psia	288.0	285.00	
Fuel Inlet Pressure, psia	292.0	287.00	
Chamber Pressure, psia	120.7	119.6	
Oxidizer Flowrate, lbs/sec	.1660	.1645	
Fuel Flowrate, lbs/sec	.1039	.1027	
Mixture Ratio, O/F	1.60	1.60	1.60 ±0.09
Main Thrust, lbs.	79.6	79.1	79.0 ±4.0
Specific Impulse, sec.	295	296	(280) min.
Electrical Power, Watts	43.0		
Oxidizer Valve Voltage, Volts	30.5		
Fuel Valve Voltage, Volts	30.56		
Oxidizer Valve Current, Amps	.721		
Fuel Valve Current, Amps.	.689		
Start Time, Millisec.	22		50 max.
Shutdown Time, Millisec.	100		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9-16-64	H/ [illegible] 1-13-65		[illegible] 1/13/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

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R-15019-2

GROUP-4
Downgraded at 3 year intervals;
declassified after 12 years

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THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C. SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 207510-701 SHEET 83 OF 121

7.1.5.2.4.5 Failure Data

Accumulated Firing Time, Sec. 384.3

Description of Failure Mode GRADUAL THROAT INSERT EROSION BEGINNING AT 210 SEC. OF BURN TIME, WITH A CORRESPONDING INCREASE IN THRUST AND DECREASE IN CHAMBER PRESSURE. AT 365 SEC. BURN TIME THE THROAT INSERT WAS EJECTED FROM THE TCA. THE TCA FAILURE OCCURRED AT 366 SEC. BURN TIME WHEN THE THROAT STATION SKIN TEMPERATURE NUMBER 1 FIRST REACHED 700°F.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	1/20/65		VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 86 OF 171

Reference:	MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20	
7.1.6	Disassembly and Inspection	
7.1.6.1	Test Procedure	
7.1.6.1.1	Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.	
7.1.6.1.2	Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 7. All cutting shall be done by saw.	C
7.1.6.1.3	Separate the propellant valves from the mounting bracket.	C
7.1.6.1.4	Section the TCA by cutting along line C-D-E as depicted in Figure 14.	
7.1.6.1.5	Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.	
7.1.6.1.6	After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves).	C
7.1.6.1.7	Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407661 (Fuel Seat Assembly P/N 407660) shall not be removed at this time.	
7.1.6.1.8	Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish	C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole		R. Heide	11-18-64		
CHECKED BY:	DATE				
K. Lewis	11-18-64				

FORM 608-B-38 NEW 6-63

Rev. C J. D. Mangeris Date 11/18/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 86.1 OF 171

(cont'd)	this shall be removed. The filter assembly P/N 5-28139-T1 shall not be removed at this time.
7.1.6.1.9	Remove, bag and identify the seat assembly.
7.1.6.1.10	Remove, bag and identify the armature P/N 407564.
7.1.6.1.11	Remove, bag and identify the spring P/N 406816.
7.1.6.1.12	Remove, bag and identify the filter assembly.
7.1.6.1.13	Bag and identify the solenoid assembly.
7.1.6.1.14	Repeat 7.1.6.1.7 thru 7.1.6.1.13 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

C C

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE				
[signature]	11-18-64	[signature]	11-18-64		

FORM 608-B-38 NEW 6-63

Rev. C J.D. Norrgang Date 11/18/64

R-15019-2

APR 28 1965
SERVICES

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 87 OF 171

7.1.6.2 Post Test Inspection Data - TCA #1

7.1.6.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 4051207

7.1.6.2.2 Preliminary Inspection (Reference paragraph 7.1.6.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows: SEVERE THERMAL DAMAGE TO COMBUSTION CHAMBER. 1ST 3 LINERS [illegible] 4TH LINER FROM EXIT [illegible] COMPLETE EROSION OF ABLATIVE, ASBESTOS-GLASS ROVING IN AREA OF 1ST 3 LINERS. ABLATIVE SEPARATION & DELAMINATION AT NOZZLE - INJECTOR IMPINGEMENT RING'S ADHERE INTACT

7.1.6.2.3 Disassembly and Inspection (Reference paragraph 7.1.6.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows: SEVERE THERMAL DAMAGE TO COMBUSTION CHAMBER - FIRST TWO LINERS FROM EXIT HAVE BEEN BURNED AWAY. THIRD LINER FROM EXIT IS 95% BURNED AWAY. SEVERE EROSION OF ABLATIVE ASBESTOS, GLASS ROVING, AND THE THROAT INSERT* AT THE ENTIRE AREA OF THE T.C.A. MIN I.D.. INNER LAMINAR DELAMINATIONS OF THE ABLATIVE THROUGHOUT ITS ENTIRE EXISTING PROFILE. DELAMINATIONS OF THE ASBESTOS AND GLASS ROVING THROUGHOUT THEIR ENTIRE EXISTING PROFILE UNCHANGED 5-25-65 * THROAT INSERT IS COMPLETELY BURNED AWAY

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. Kniffin		7.1.6.2.1 [illegible] 5-19-65; 7.1.6.2.2 5-19-65		7.1.6.2.1 [illegible] 5-19-65; 7.1.6.2.2		WAIVED BY S. SCOTT T. A. GRAINIERE	5-25-65
						VERIFIED BY USAF	DATE
						[illegible]	5/26/65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-27[illegible] / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 401 OF 471

7.1.6.2.4 **Disassembly of Propellant Valves (Reference Paragraphs 7.1.6.1.7 thru 7.1.6.1.13).** C

The propellant valves were disassembled and all parts called for were bagged and identified Yes **(yes or no).**

OXID VALVE DISASSEMBLED BUT ARMATURE & SPRING WOULD NOT COME OUT. FUEL VALVE DISASSEMBLED SOLENOID HAS NUMEROUS SCRATCHES IN ARMATURE HOUSING. ARMATURE HAS NUMEROUS SCRATCHES.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
D. Cole D.C. 11-20-64	A 807-6 6/9/65	J.K. Sullivan 6/9/65	[illegible] 6/9/65
			VERIFIED BY USAF / DATE: [illegible] 6/9/65

FORM 608-B-39 NEW 6-63

Rev C A.D. Mangrum Date 11-20-64

R-15019-2

VN17 #2

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4051206

Dwg. No. 207510-21

Model SR-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
		CTL III			
		PART NO. [illegible] COMPLETE S.S.			
		DATE 10 Nov 64 INSP.			
ACTION TAKEN					
1	10/30/64	PART NO. 106126-31 ADAPTERS (2) HAVE HAD PARTIC.			
		OR CLEANING VERIFICATION.			
ACTION TAKEN		Adapter Cleaned & Orifice indent. installed	11/3/64		
V	11/3/64	PART NO. 207510-21 S/N 4051206 TCA 5/16" INTO INLET			
		LINE HAS A TWIST IN LINE, ALSO LOOKING AT			
		Weld.			
ACTION TAKEN		TRANSFERRED TO SHORTAGE SHEET			
		PART NO. INSP. COMPLETE S.S.			
		DATE [illegible] INSP.			
ACTION TAKEN					
3	11/15/64 ANR 815	PART NO. 207510-21 S/N 4051206 REMOVED AND REPLACED DISCREPANT			
		PROPELLANT VALVE INLET ADAPTER P/N 99-106126-31 PER RAO 607-007			
		REF DCP #2 J.H. Beatty STA-333			
ACTION TAKEN		INFORMATION ONLY	11/15/64	11/15/64	11/15/64
256		NO ACTION REQUIRED	ANR 815	R-15019-2	

Form R 25-U Rev. 12-57

UNIT # 2

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4051206

Dwg. No. 207510-2

Model S-4?

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
		CTL-3			
4	11-21-61	PART NO. 207510-21 S/N 4051206 TCA SKIN Temp Exceeded 700° Prior to Completion of Soak-out Ref Para 6.7.12			
		ACTION TAKEN	11 ANR 930	11-22	
5	11-21-61	PART NO. 207510-21 S/N 4051206 TCA - Decontaminate Completed up to PARA 6.8.9			
		ACTION TAKEN	11	11-22	
		PART NO. Insp. Complete at C.T.E. 3			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			

R-15019-2

Form R 25-u Rev. 12-57

SHORTAGE REPORT

☑ ELEC. ☐ MECH. ☐ ORIG. ☐ DUP.

ASSEMBLY NAME	ASSEMBLY NO.	L.H.	R.H.	UPPER	LOWER
SE7	207510-21				

DEPARTMENT NO.	SHIP OR UNIT NO.	CONTRACT NO.	SERIAL NO.	DATE
096	7	5246	405120C	

SHORTAGES CHECK ONE ACTUAL	SHORTAGES CHECK ONE HELD UP	INSP. VERI.	QUAN.	PART NUMBER	COMPLETE PART NAME	DATE	MECH.	L.H.	INSP.
					COMPLETE S.S.				
					DATE ... INSP.				
✓		(INSP)	1	207510-21	S/N 405120C TCD 5/16" HTO				
					INLET LINE has A TWIST IN				
					The LINE Also LEAKING AT				
					Weld. Ref Dcp # 2				
					INSP. COMPLETED				
					DATE ... INSP.				
					OK TO SHIP J. Wilson 11/4/64				

This sheet is to be prepared in duplicate by the production department. All entries will be made with pen, indelible pencil or with a typewriter. Responsible production personnel will place a check mark (V) in the applicable column to indicate whether the shortage is actual or held up. Inspection will add the original and/or the duplicate shortage sheets to the sign-off book and verify correct entries by placing an inspection stamp impression in the applicable block.

SHORTAGE REPORT

☐ ELEC. ☒ MECH. ☒ ORIG. ☐ DUP.

ASSEMBLY NAME	ASSEMBLY NO.	L.H.	R.H.	UPPER	LOWER
SE-7	207510-21	—	—	—	—

DEPARTMENT NO.	SHIP OR UNIT NO.	CONTRACT NO.	SERIAL NO.	DATE
C96	2	3724C	405120C	

SHORTAGES CHECK ONE ACTUAL	SHORTAGES CHECK ONE HELD UP	INSP. VERI.	QUAN.	PART NUMBER	COMPLETE PART NAME	DATE	MECH.	L.M.	INSP.
✓		NOV 9 '64	1	207510-21	S/N 405120C TCA SKIN TEMP				
					EXCEEDED 700 DEG F. COMPLETION				
					OF SOAK-OUT REF PARA. 6.7.12.				
					REF DCP #4 11/4/64				
					Insp. Complete at C.T.L. - 3				
					NOV 9 '64				
					OK TO SHIP J. Wilson 11/9/64				

This sheet is to be prepared in duplicate by the production department. All entries will be made with pen, indelible pencil or with a typewriter. Responsible production personnel will place a check mark (✓) in the applicable column to indicate whether the shortage is actual or held up. Inspection will add the original and/or the duplicate shortage sheets to the sign-off book and verify correct entries by placing an inspection stamp impression in the applicable block.

R-15019-2

AM 61-Y, REV. 3-56

Date: 10-10-64 Cell No. 39-L 85# Moore Kelly

85# DAT

	Part		
	TCA	207510-21	4051206
	Injector	UNK	4058119
	Adhesive Mass		UNK
	Cntl. Valve	407561	4054491
	Fuel Valve	407662	4058119

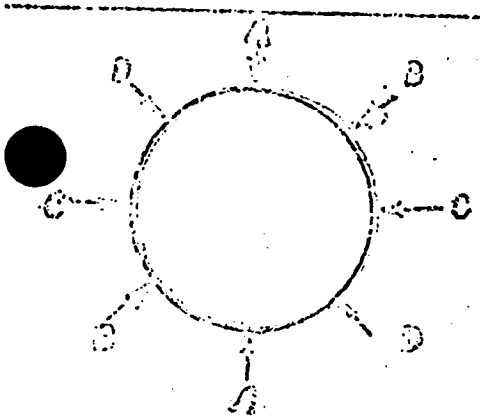
Shot No.	Time	Duration	Altitude	Shot Remarks
025	2320	60sec	145,000'	Thrust Vector

TCA Leak Check Performed (PM) TFO (930) System Leak Check Performed (PM)

Cntl. Valve Opening Verified (PM) TFO (930) Fuel Valve Opening Verified (PM) TFO (930)

Pre Test Injector Inspection. Remarks— OK

Pre Test Throat Insert Inspection. Remarks— Good



INJECTOR AND NOZZLE DIMENSIONS

	Pre	
A-A	.6725	6725
B-B	.6725	6725
C-C	.6726	6725
D-D	.6726	6725
E-E	4.214	4.215
Weight		

Cont. MCO P/N S/N 3006 Cont. MCO P/N S/N 3633

Remote MCO P/N S/N Pressure Xducer S/N

Remarks No Orifice TAGS

Unit 22

11-7-64 "K" 85# Moore

DAT

	207510-21	4051206	
		4058119	
		4104K	
	407321	4054991	
	407662	4051671	

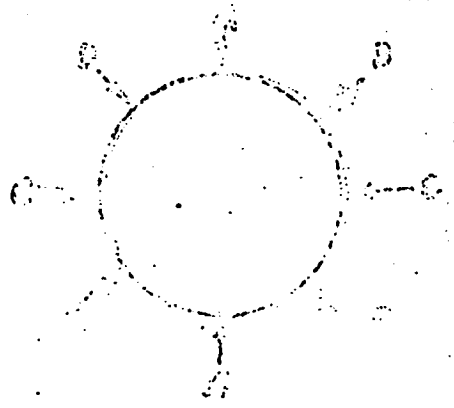
.093	START 2321 STOP 2324	2.19	145,000	Duty cycle
.094	2335	2.0sec	145000	Burst test

TCV Limit Check Performed (G) Fuel Leak Test Performed (G)

Ox Valve Operating Verified (G) Fuel Valve Operating Verified (G)

Fuel Inlet Adjustable Restrictor Removed Good

Ox Inlet Flow Control Orifice Inspected Good



A.A.	.6725	A.A.	.6624
B.B.	.6725	B.B.	.6650
C.C.	.6725	C.C.	.6677
D.D.	.6725	D.D.	.6616
Ave.	4.215	Ave.	4.112

Ox Inlet Pressure 2927 Fuel Inlet Pressure 2860

R-15019-2 Ox'd Orifice .07209
Fuel Orifice .06502

Post Test ① HEAVY CHARRING OVER OF THROAT AREA, ② CONSIDERABLE BLISTERING & SEPERATION OF ABLATIVE MATERIAL D/S OF THROAT

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207510-401 SHEET 88 OF 171

Reference: MAC SCD 52-52701, Revision F, Figure 12

7.2 Thrust Chamber Assembly - #2

This subsection specifies the tests which are to be performed on Thrust Chamber Assembly No. 2.

PREPARED BY: E. Adams EA DATE 4/15/64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: DATE 4/17		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 89 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.2.1

7.2.1 Pre-Test Inspection - TCA #2

7.2.1.1 Test Procedure

7.2.1.1.1 Verify that the TCA is of the proper configuration, that it has been properly packaged and that it contains no defects such as broken parts, corrosion, damage or deterioration. Also verify that the TCA has passed the Acceptance Tests of RA0220-348. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.2.1.1.2 Braze propellant valve inlet adapters to the oxidizer and fuel propellant valves per RA0607-009.

7.2.1.1.3 Perform Weight Determination per paragraph 6.6.

PREPARED BY: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/17	4-18-64			

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 90 OF 171

7.2.1.2 Test Data - TCA #2

7.2.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-275		
Rocketdyne Part No.	207510-21	407561	407662
Component Serial No.	405206	405491	405671

7.2.1.2.2 Inspection (reference paragraph 7.2.1.1)

7.2.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, that it had been properly packaged and that it contained no defects such as broken parts, corrosion, damage or deterioration. Also the TCA records were inspected and it was verified that the TCA had passed the acceptance tests of RA0220-348 YES (yes or no).

7.2.1.2.2.2 Propellant valve inlet adapters were installed per Figure 11 and 11A on the propellant valves per paragraph 7.2.1.1.2 YES (yes or no).

7.2.1.2.2.3 Propellant valve inlet adapters were rotated per Figure 11B after thrust vector tests YES (yes or no). A

7.2.1.2.2.4 Inspection Remarks: REF SCN #1

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
10-6-64 E. Adams			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

Rev. A J. D. Hargreaves dated 10-6-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 91 OF 171

7.2.1.2.3 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.
YES (Yes or No)

The TCA dry weight was 8.47 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

NONE

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	F. E. Pope 10-7-64	10-7-64	WAIVED BY J. MANROGENIS 10/7/64
			VERIFIED BY USAF 10/7/64 DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 92 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

7.2.2 Thrust Vector - TCA #2

7.2.2.1 10/14/64 Test Procedure

7.2.2.1.1 10/14/64 Perform thrust vector firing test per paragraph 6.7. Make two 0.25 second pulses without oscillograph instrumentation followed by two 2.75 second duration tests to determine the direction of the thrust vector with respect to the TCA longitudinal axis. The off time between each firing shall be three (3.0) seconds. The TCA shall demonstrate specification performance for the two steady state test firings.

7.2.2.1.2 Reduce data per RAO 220-231 and SEM 4388-4041.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	9/17/64	R. J. Eide	9-17-64		
CHECKED BY: K. W. Dennis	DATE 9-17-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

#2

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 93 OF 171

7.2.2.2 Test Data - TCA #2

7.2.2.2.1 Component Identification

Component Name Thrust Chamber Rocketdyne Part No. 207510-21

McDonnell Part No. 52-52701-275 Component Serial No. 4C51206

Accumulated Acceptance Test Firing Time, seconds 9.0 Sec.

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	6.725	6.725
Nozzle Exit Diameter, inches	4.214	4.215

* Thrust Fixture Dim. "A"	10.687
* Thrust Fixture Dim. "K"	6.750
* Misalignment Thrust F_{xu}	-.4866
* Misalignment Thrust F_{xL}	Zero
* Misalignment Thrust F_{yu}	.2528
* Misalignment Thrust F_{yL}	.0256

*(Refer to Figure 13)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
J. Ganger 9/17/64	R Cole 1-17-65	W. C. Williams 3/3/65	James D. Thompson 2/24/65
			VERIFIED BY USAF / DATE 3/4/65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 854 PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 94 OF 171

7.2.2.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	10-5-64	10-5-64
Sample Batch Number	10-68	10-69
Sample Temperature, F	64°	66
Sample Specific Gravity	1.463	.876
Met Mil Spec. Requirements (yes or no)	Yes	Yes

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
J. Ganger 9/17/64	10/10/64	11/7/64	Waived VIA Telecon 11/4/64
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 95 OF 171

7.2.2.2.3 Thrust Vector Test (reference paragraph 7.2.2.1)

Test Cell Location STL-3 cell 39

Test Cell Number 39 L

Test Number 025

Test Date 10-10-64

	Site Data		Standard Vacuum	
	Run 1	Run 2	Run I	Run 2
Firing Duration, sec	2.7	2.6		
Accumulated Firing Time, sec	13.3	15.8		
Data Slice Number	1	2		
Time of Data Slice	2.6	2.5		
Ambient Pressure, in. Hg	28.01	28.01		
Ambient Temperature, F	70	70		
Environmental Pressure, psia	.0118	.0118	0	0
Oxidizer Temperature, F	71	71	70.0	70.0
Fuel Temperature, F	69	69	70.0	70.0

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E/I 4/15/64 E. Adams	/s/ Robinson 1-11-65	W. C. Williams 3/3/65	2/23/65 VERIFIED 3/4/65

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 95.1 OF 171

7.2.2.2.3 (cont'd)	Site Data Run 1	Site Data Run 2	Standard Vacuum Run 1	Standard Vacuum Run 2	
Oxidizer Inlet Pressure, psia	~~282~~	~~282~~	285	285	
Fuel Inlet Pressure, psia	290.5	290.0	287	287	
Oxidizer Flowrate, lbs/sec	.1680	.1675	.1692	.1686	
Fuel Flowrate, lbs/sec	.1039	.1039	.1027	.1028	
Mixture Ratio, O/F	1.62	1.61	1.65	1.64	1.60 ±0.09
Main Thrust F_z lbs	78.4	78.7	78.7	78.9	79 ±4.0
Specific Impulse, sec.	288	290	289	291	280 minimum
Lateral Thrust F_{xL} lbs	2.4	2.56			
Lateral Thrust F_{yL} lbs	.0296	.0256			
Lateral Thrust F_{xu}, lbs	-.9866	-.3876			
Lateral Thrust F_{yu}, lbs	.252	.198			
Thrust Vector Angle (ϕ) from TCA centerline, degrees	5.04	5.21	5.31	5.48	(5.5±0.5)
Electrical Power, Watts	38.9	39.3			
Oxidizer Valve Voltage, Volts	28.4	28.7			
Fuel Valve Voltage, Volts	28.6	28.6			
Oxidizer Valve Current, Amps.	.676	.683			
Fuel Valve Current, Amps.	.688	.688			
Start Time, Millisecond	35	37			50 maximum
Shutdown Time, Millisecond	110	96			125 maximum

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 3-5-64	W. J. McGuire 1-13-65	W. C. Williams 3/3/65	James D. Marquess 3/23/65
			VERIFIED BY USAF DATE 3/24/65

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FORM 608-B-39 NEW 6-63

R-15019-2

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

~~CONFIDENTIAL~~

Downgraded at 3 year intervals; declassified after 12 years. DOD DIR 5200.10

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. N207510-401 SHEET 96 OF 171

7.2.3 DAT Duty Cycle to 147 Seconds - TCA #2

7.2.3.1 Test Procedure

7.2.3.1.1 Perform fuel and oxidizer propellant valve orifice removal per paragraph 6.9.

7.2.3.1.2 Install fuel and oxidizer propellant valve orifice adapter (P/N 99-106726, P/N 99-106727) in the facility propellant feed system. (See Figure 6)

7.2.3.1.3 Install fuel and oxidizer valve metering orifice and retaining ring in the facility mounted orifice adapter. 11/3/64

7.2.3.1.4 Adjust instrumentation ranges per Table I and Note 5.

7.2.3.1.5 Perform DAT Duty Cycle Test per paragraph 6.7 and Table II. The TCA shall demonstrate specification performance to 147 seconds. The firing test shall be terminated upon completion of Pulse Number 8.

7.2.3.1.6 Maintain pressure altitude and monitor TCA exterior wall temperatures until peak temperature is reached. The maximum allowable temperature shall not exceed 700 F.

NOTE: Do not reduce altitude or remove the TCA from the test stand. Perform the procedures of paragraph 7.2.4.1.1 thru 7.2.4.1.3 during TCA temperature soakout period. Within 30 seconds after soakout period complete the procedures of paragraphs 7.2.4.1.4 thru 7.2.4.1.10.

PREPARED BY: E. Adams	DATE 10-15-64	APPROVED FOR NAA: R.J. Ecker	DATE 10-15-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: [illegible]	DATE 10-15-64				

FORM 608-B-38 NEW 6-63

R-15019-2 rev. A J. D. [illegible] dated 10-15-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 207510-401 96.1 SHEET 171 OF ____

7.2.3.1.7 Reduce Data per RAO 220-231.

7.2.3.1.7.1 The results of significant data shall include but not be limited to the following:

7.2.3.1.7.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations including soakout.

7.2.3.1.7.1.2 Graphical presentation of thrust versus time.

7.2.3.1.7.1.3 Graphical presentation of chamber pressure versus time.

7.2.3.1.7.1.4 Graphical presentation of oxidizer flowrate versus time.

7.2.3.1.7.1.5 Graphical presentation of fuel flowrate versus time.

PREPARED BY: E. Adama	DATE 9-15-64	APPROVED FOR NAA: R Heide	DATE 10-8-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: R E G	DATE 10-9-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 207510-401 SHEET 97 OF 171

7.2.3.2 Test Data - TCA #2

7.2.3.2.1 Component Identification

Component Name 85# TCA

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. ~~4065-4~~ V0 1051206

Accumulated Acceptance Test Firing Time, seconds 15.0 sec

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	.6725	.6649
Nozzle Exit Diameter, inches	4.215	4.112

7.2.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	11-2-64	11-2-64
Sample Batch Number	11-2	11-1
Sample Temperature, F	64°	66°
Sample Specific Gravity	1.450	.878
Met Mil Spec. Requirements (Yes or No)	Yes	Yes

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams EA 4/15/64	A.E. Hanlon 11/7/64	Mel Moore 11/7/64	Waived via Tele-con 11/7/64
			VERIFIED BY USAF DATE 11/7/64

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 207510-401 SHEET 98 OF 171

7.2.3.2.3 Duty Cycle Test (reference paragraph 7.2.3.1)

Test Cell Location CTL-3

Test Cell Number 39-K

Test Number 093

Test Date NOV 7 '64

The fuel and oxidizer propellant valve orifices were removed from the TCA per paragraph 6.9. yes (yes or no)

The fuel and oxidizer propellant valve orifice adapters were installed in the facility feed system. 11/4/64 (yes or no)

The fuel and oxidizer propellant valve metering orifices were installed in the facility mounted orifice adapters. 11/4/64 (yes or no)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	9-15-64	[illegible]	11/7/64	Mel Moore	11/7/64	Waived via Tele-con	11/7/64
						VERIFIED BY USAF	DATE
						[illegible]	11/7/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 347 SECONDS TEST NO. 207510-401 SHEETS 274 OF 171

7.2.3.2.4 Duty Cycle Test (reference paragraph 7.2.3.1)

Test Cell Location CTL-3

Test Cell Number 39-K

Test Number 093

Test Date 11-7-64

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
J. Ganger	9/17/64	[signature]	11/7/64	Mel Moore	11/7/64	Waived via Tele-con	11/7/64
						VERIFIED BY USAF	DATE
						[signature]	11/7/64

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 207510-401 SHEET ___ OF ___

IL 5388-6250

Deviation Request:

It is hereby authorized to accept the following deviations from the DAT Specification 207510-401 for 85# TCA Unit 2:

1. The TCA thrust (84 pounds) exceeded the specification limit of 79 ±4 pounds for all MDC pulses.

2. The TCA mixture ratio (M/R = 1.7) exceeded the specification limit of 1.60 ±.09 for all MDC pulses.

   The high values of thrust and M/R were a result of a smaller TCA orifice pressure drop (Δ P) during the MDC.

   For the MDC and subsequent Burst Pressure Test the TCA orifices were removed from the thrust chamber and installed in the test facility. During the MDC the orifice ΔP's, particularly the oxidizer orifice, were smaller than they had been during the Hot Fire Acceptance and the DAT Thrust Vector Tests.

   An analysis of the data has disclosed that the change in thrust and M/R, from the Acceptance and DAT Thrust Vector tests to the DAT MDC, can be accounted for by the decrease in TCA orifice ΔP, and that the recorded test data is correct.

John A. Ganger
John A. Ganger
Gemini DAT-RAT Unit

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
2-24-65

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

~~CONFIDENTIAL~~

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# #2 PART NO. { MAC 52-52701-275 / NAA 2075 10-21

NAME OF TEST DAT DUTY CYCLE TO 1147 SECONDS TEST NO. 2075 10-701 SHEET 28 OF 171

7.2.3.2.4.1 Pluse No. 1-111 seconds on-time followed by 160 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	112.2		
Accumulated Firing Time, sec	25.8		
Data Slice Number	1		
Time of Data Slice	10		
Ambient Pressure, in. Hg	28.015		
Ambient Temperature, F	52		
Environmental Pressure, psia	.0262	0	
Environmental Temperature, F	80		
Oxidizer Temperature, F	54	70.00	
Fuel Temperature, F	55	70.00	
Oxidizer Inlet Pressure, psia	279.8	285.00	
Fuel Inlet Pressure, psia	292.8	287.00	
Chamber Pressure, psia	133.3	133.2	
Oxidizer Flowrate, lbs/sec	.1799	.1816	
Fuel Flowrate, lbs/sec	.1086	.1061	
Mixture Ratio, O/F	1.66	1.71	1.60 ±0.09
Main Thrust, lbs.	84.1	84.4	79.0 ±4.0
Specific Impulse, sec.	292	293	(280) min.
Electrical Power, Watts	39.8		
Oxidizer Valve Voltage, Volts	28.9		
Fuel Valve Voltage, Volts	27.9		
Oxidizer Valve Current, Amps	.709		
Fuel Valve Current, Amps.	.692		
Start Time, Millisec.	30		50 max.
Shutdown Time, Millisec.	48		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9/17/64	J. Robinson 1-14-65	W.C. Williams 3/8/65	[illegible] 2/24/65
			VERIFIED BY USAF / DATE [illegible] 3/4/65

FORM 608-B-39 NEW 6-63

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R-15019-2

GROUP-4
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Declassified after 12 years

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 2075 10-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 2075 10-401 SHEET 92 OF 171

		Site Data	Standard Vacuum	
7.2.3.2.4.2	Pluse No. 2- 10 seconds on-time followed by 1.0 seconds off-time			
	Firing Duration, sec	10.1		
	Accumulated Firing Time, sec	133		
	Data Slice Number	2		
	Time of Data Slice	5		
	Ambient Pressure, in. Hg	28.015		
	Ambient Temperature, F	52		
	Environmental Pressure, psia	.0236	0	
	Environmental Temperature, F	160		
	Oxidizer Temperature, F	57	70.00	
	Fuel Temperature, F	58	70.00	
	Oxidizer Inlet Pressure, psia	286.8	285.00	
	Fuel Inlet Pressure, psia	288.8	287.00	
	Chamber Pressure, psia	133.8	132.6	
	Oxidizer Flowrate, lbs/sec	.1825	.1506	
	Fuel Flowrate, lbs/sec	.1070	.1064	
	Mixture Ratio, O/F	1.71	1.70	1.60 ±0.09
	Main Thrust, lbs.	84.6	84.2	79.0 ±4.0
	Specific Impulse, sec.	292	293	(280) min.
	Electrical Power, Watts	37.6		
	Oxidizer Valve Voltage, Volts	28.9		
	Fuel Valve Voltage, Volts	27.9		
	Oxidizer Valve Current, Amps	.675		
	Fuel Valve Current, Amps.	.648		
	Start Time, Millisec.	23		50 max.
	Shutdown Time, Millisec.	60		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9/17/64	M. Robinson 1-14-65	W.C. Williams 3/3/65	James R. Browning 3/24/65
			VERIFIED BY USAF / DATE T. Chin 3/4/65

FORM 608-B-39 NEW 6-63

R-15019-2

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GROUP-4
Downgraded at 3 year intervals; declassified after 12 years

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 207510-401 SHEET 100 OF 171

7.2.3.2.4.3 Pluse No. 6-1.0 seconds on-time followed by 1.0 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	1.0		
Accumulated Firing Time, sec	147		
Data Slice Number	3		
Time of Data Slice	.9		
Ambient Pressure, in. Hg	28.615		
Ambient Temperature, F	52		
Environmental Pressure, psia	.020	0	
Environmental Temperature, F	171		
Oxidizer Temperature, F	57	70.00	
Fuel Temperature, F	58	70.00	
Oxidizer Inlet Pressure, psia	293.8	285.00	
Fuel Inlet Pressure, psia	293.8	287.00	
Chamber Pressure, psia	136.3	133.1	
Oxidizer Flowrate, lbs/sec	.1806	.1758	
Fuel Flowrate, lbs/sec	.1055	.1039	
Mixture Ratio, O/F	1.71	1.69	1.60 ±0.09
Main Thrust, lbs.	83.5	81.9	79.0 ±4.0
Specific Impulse, sec.	292	293	(280) min.
Electrical Power, Watts	36.8		
Oxidizer Valve Voltage, Volts	29.0		
Fuel Valve Voltage, Volts	27.9		
Oxidizer Valve Current, Amps	.660		
Fuel Valve Current, Amps.	.632		
Start Time, Millisec.	30		50 max.
Shutdown Time, Millisec.	55		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams	W. Schumann 1-14-65	W. C. Walker 3/3/65	James D. Harmon 3/24/65
			VERIFIED BY USAF / DATE 3/4/65

FORM 608-B-39 NEW 6-63
R-15019-2

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~~GROUP-4~~
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declassified after 12 years

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 20751 0-21

NAME OF TEST DAT DUTY CYCLE TO 147 SECONDS TEST NO. 20751 0-401 SHEET 101 OF 171

		Site Data	Standard Vacuum	
7.2.3.2.4.4	Pluse No. 8-0.5 seconds on-time followed by 0.5 seconds off-time			
	Firing Duration, sec	.5		
	Accumulated Firing Time, sec	148		
	Data Slice Number	4		
	Time of Data Slice	.3		
	Ambient Pressure, in. Hg	28.015		
	Ambient Temperature, F	52		
	Environmental Pressure, psia	.020	0	
	Environmental Temperature, F	176		
	Oxidizer Temperature, F	57	70.00	
	Fuel Temperature, F	58	70.00	
	Oxidizer Inlet Pressure, psia	298.8	285.00	
	Fuel Inlet Pressure, psia	298.8	287.00	
	Chamber Pressure, psia	133.8	129.2	
	Oxidizer Flowrate, lbs/sec	.1608	.1741	
	Fuel Flowrate, lbs/sec	.1062	.1035	
	Mixture Ratio, O/F	1.70	1.68	1.60 ±0.09
	Main Thrust, lbs.	84.2	81.6	79.0 ±4.0
	Specific Impulse, sec.	293	294	(280) min.
	Electrical Power, Watts	36.8		
	Oxidizer Valve Voltage, Volts	29.0		
	Fuel Valve Voltage, Volts	28.1		
	Oxidizer Valve Current, Amps	.656		
	Fuel Valve Current, Amps.	.632		
	Start Time, Millisec.	.30		50 max.
	Shutdown Time, Millisec.	57		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams	W. R. Lucas	W. C. Williams 3/3/65	James D. Marrogenic 2/24/65
			VERIFIED BY USAF / DATE: 3/4/65

FORM 608-B-39 NEW 6-63
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R-15019-2

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST BURST PRESSURE TEST NO 207510-401 SHEET ___ OF ___

IL 4388-5409

Deviation Request:

The Burst Pressure Test data of paragraph 7.2.4.2 on page 103 will be completed when data is available. Proceed with Wt. Determination of paragraph 6.6 and 7.2.4.2.3.

Recopied from original request dated 12, November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

E Adams
E. Adams
Gemini DAT-RAT Unit

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-27 / NAA 207510-21

NAME OF TEST BURST PRESSURE TEST NO. 207510-401 SHEET 102 OF 171

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.2.2

7.2.4 Burst Pressure - TCA #2

7.2.4.1 Test Procedure

7.2.4.1.1 Open the oxidizer and fuel facility by-pass valves. See Figure 6.

7.2.4.1.2 Close the facility propellant valves. See Figure 6.

7.2.4.1.3 Adjust the test facility propellant tank pressures to 750 $^{+0}_{-20}$ psig. The parameters to be recorded during the firing test are combustion chamber exterior wall temperature, facility propellant tank pressures, TCA inlet pressures, and chamber pressure.

7.2.4.1.4 Activate instrumentation.

7.2.4.1.5 Open the TCA propellant valves.

7.2.4.1.6 Within one second after TCA propellant valve opening, open the facility propellant valves simultaneously.

7.2.4.1.7 Fire the TCA for three seconds following facility propellant valve opening. The firing test shall be terminated by closing the TCA propellant valves.

7.2.4.1.8 The TCA shall demonstrate operation without catastrophic chamber failure as defined in Table II, note 4.

7.2.4.1.9 Perform decontamination per paragraph 6.8.

7.2.4.1.10 Perform weight determination per paragraph 6.6.

11/15/64

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J.A. Ganger	10-6-64				
CHECKED BY:	DATE				
R Polo	10-8-64	R Eida	10-8-64		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-475 / NAA 207510-21 }

NAME OF TEST BURST PRESSURE TEST NO 207510-401 SHEET ___ OF ___

IL 5388-6251

Deviation Request:

It is hereby authorized to accept the following deviation from the LAT Specification 207510-401 for 85# TCA Unit #2.

The MNH inlet pressure DIGR did not record the pressure during the Burst Pressure Test. However, a value for the Burst Pressure Test Inlet Pressure has been calculated at 710 psia.

John A. Ganger
John A. Ganger
Gemini DAT-RAT Unit

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
2-23-65

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST BURST PRESSURE TEST NO. 207510-401 SHEET 103 OF 171

7.2.4.2 Test Data - TCA #2

7.2.4.2.1 Component Identification

Component Name 85# TCA

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 4051206

7.2.4.2.2 Site Data

Facility oxidizer tank pressure (psig) 738 (750^{+0}_{-20})

Facility fuel tank pressure (psig) 749 (750^{+0}_{-20})

Oxidizer inlet pressure (psia) 750.8

Fuel inlet pressure (psia) ____*

Combustion chamber pressure (psia) 367.7

Combustion chamber exterior wall temperature 734** (700 F max)
(maximum during firing)

* REFERENCE DEVIATION REQUEST, I.L. 5388-6215

** REFERENCE "OFR" NO. 12923 R

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	7/22/65		7/22/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST BURST PRESSURE TEST NO. 207510-401 SHEET 10 OF 171

7.2.4.2.3 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.
YES (Yes or No)

The TCA dry weight was 8.10 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

11-13-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	D. Fowler 11-18-64	11/13/64	Waived by 11/4/64
			VERIFIED BY USAF / DATE 11/13/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO 207510-401 SHEET 105 OF 171

Reference:	MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20	
7.2.5	Disassembly and Inspection	
7.2.5.1	Test Procedure	
7.2.5.1.1	Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.	
7.2.5.1.2	Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 7. All cutting shall be done by saw.	C
7.2.5.1.3	Separate the propellant valves from the mounting bracket.	C
7.2.5.1.4	Section the TCA by cutting along line C-D-E as depicted in Figure 14.	
7.2.5.1.5	Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.	
7.2.5.1.6	After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves).	C
7.2.5.1.7	Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407661 (Fuel Seat Assembly P/N 407660) shall not be removed at this time.	
7.2.5.1.8	Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish	C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole					
CHECKED BY:	DATE				
	11-18-64		11-18-64		

FORM 608-B-38 NEW 6-63

Rev. C/ D. Barragano Date 11/18/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 105 OF 171

(cont'd)	this shall be removed. The filter assembly P/N 5-28139-T1 shall not be removed at this time.
7.2.5.1.9	Remove, bag and identify the seat assembly.
7.2.5.1.10	Remove, bag and identify the armature P/N 407564.
7.2.5.1.11	Remove, bag and identify the spring P/N 406816.
7.2.5.1.12	Remove, bag and identify the filter assembly.
7.2.5.1.13	Bag and identify the solenoid assembly.
7.2.5.1.14	Repeat 7.2.5.1.7 thru 7.2.5.1.13 for the fuel propellant valve.

C

C

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole		R. Heide	11-18-64		
CHECKED BY:	DATE				
K. Langel	11-18-64				

FORM 608-B-38 NEW 6-63

Rev. C J. D. Mangan Date 11/18/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-527[illegible]-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-[illegible] SHEET 106 OF 171

7.2.5.2 Post Test Inspection Data - TCA #2

7.2.5.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-5270-275

Rocketdyne Part No. 207510-21

Component Serial No. 4051206

7.2.5.2.2 Preliminary Inspection (Reference paragraph 7.2.5.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows: VALVE ASS'Y. BACK SIDE OF INJECTOR & T.C.H SHELL ALL LOOKED GOOD SAME. OUTSIDE OF SHELL AT 1 INCH FROM NAME PLATE HAS A REGION OF SCORING SAID ABOVE SHELL. EXIT; AT EXIT END OF CHAMBER IS MELTED, NEGATIVE IS DELAMINATED AT EXIT END OF CHAMBER, ALSO INSIDE CHAMBER APPROXIMATELY FROM THROAT NEGATIVE HAS DELAMINATED STOPS APPROX END OF CHAMBER.

7.2.5.2.3 Disassembly and Inspection (Reference paragraph 7.2.5.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

6 OF 7 GRAPHITE LINERS & THROAT INSERT SHATTERED INTO MANY PIECES. ABLATIVE I.D. IS DELAMINATED IN ALL AREAS. ASBESTOS SHOWS SEPARATIONS AT CHAMB. SEGMENT AREA. LATERAL SEPARATIONS IN ABLATIVE MATERIAL OF CHAMBER SEGMENTS.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
T. Kniffin	BOTH 34 4/[illegible]	PARA 7.2.5.1.3 [illegible]	[illegible] 4/27/65
			VERIFIED BY USAF / DATE [illegible] 4/27/65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 106 OF 171

7.2.5.7.4 Disassembly of Propellant Valves (Reference Paragraphs 7.2.5.1.7 thru 7.2.5.1.13.). C

The propellant valves were disassembled and all parts called for were bagged and identified YES (yes or no).

NO COMMENTS

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
D. Cole 11-20-64	A 807-6 5/12/65	5/12/65	5/12/65
			VERIFIED BY USAF / DATE 5/13/65

FORM 608-B-39 NEW 6-63
Rev C L. D. Marroquin Date 11-20-64

R-15019-2

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4053579

Dwg. No. 205710-21

Model S2-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
		C T L # 3			
1	ANR 9-30	PART NO. 205710-21 S/N 4053579 Post test .024 Decontamination Accomplished up to C.8.30			
ACTION TAKEN		Decontamination Complete	OCT 9 '64 ANR	OCT 9 '64 ANR	OCT 9 '64
		PART NO. INSP. COMPLETE S.S. EPI DATE OCT 10 '64 INSP.			
ACTION TAKEN					
2	10/16/64 ANR 9-30	PART NO. 205710-21 S/N 4053579 Post Test .087 Decontamination Accomplished up to C.8.30			
ACTION TAKEN		DECONTAMINATION COMPLETE	OCT 17 '64 ANR 930	OCT 17 '64 ANR 930	OCT 17 '64
		PART NO. Insp. Complete at C.T.L. 3 OCT 17 '64 EPI			
ACTION TAKEN					
3	ANR 9-30 10/27/64	PART NO. WATER TEMP. PER 7.3.4.2.9.1 WAS 210°F S/B 200±5°F REF PARA 7.3.4.1.14. R-15019-2			
ACTION TAKEN 290		SEE T.L. DATED 10/28/64 PARA. 1)	X ANR 9-4 10/28/64		ANR 9-4

Form R 25-u Rev. 12-57

UNIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 1165374

Dwg. No. 2257IC-01

Model PSE-1

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
A	ANR 10/27/64	PART NO. FAILED RESPONS TIME PER PARA. 7.3.4.2.11. THE OPENING TIME FOR THE OXIDIZER VALVE WAS .0215 SEC. S/B .021 SEC MAX REF. PARA. 6.54.			
		ACTION TAKEN: SEE I.L. DATED 10/28/64 PARA. 2.)	X	ANR	10/28/64
S	ANR 160	PART NO. DURING SERVICE LIFE TEST AT 15°F EXCESSIVE LEAKAGE OCCURRED DUE TO CRACKS IN THE THROAT SECTION: (INSERT)			
		ACTION TAKEN: REF. IL DATED 11/2/64 & 11/3/64	ANR 160	ANR 160	11/3/64
6	ANR 160	PART NO. DURING FUEL PROP VALVE DIELECTRIC TEST PER PARA. 4.2 FOLLOWING 50,000 CYCLES @ 15°F "H" LEAD WITH 300 VDC APPLIED AND A CURRENT LEAKAGE OF 4,000 MICROAMPS S/B 500 MAX WITH 500 VDC APPLIED			
		ACTION TAKEN: REF IL ~~DTD~~ #4388-5180 DTD 10 NOV 64		ANR 224	11-11-64
		PART NO.			
		ACTION TAKEN:			
		PART NO.			
		ACTION TAKEN:			

VISIT #3

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 405357

Dwg. No. 207510-2

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY: Mech. & Date	Lead-man & Date	Insp. & Date
		Customer			
#1	9/11/64	PART NO. 207510 CUSTOMER (AF) WAIVERS VERIFICATION OF T.C.A. ~~AFTER HOT FIRE~~ DECONTAMINATION AFTER HOT-FIRE PER PARA. 6.6			
		ACTION TAKEN: INFO. ONLY			
#2	11/5/64	PART NO. PARA 6.3.3 REFERS TO FIGURE 12 FOR THE RESISTANCE/TEMP PLOTS. THESE PLOTS ARE FOUND ON FIGURE 10.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			
		PART NO.			
		ACTION TAKEN			

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R-15019-2

Form R 25-U Rev. 12-57

N 5-64 391 85# KELLY

SEA	207510-21	405 3277	
Safe/Arm	LINK	LINK	
Det Amp Mono	LINK	LINK	
Det. Amp	407662	918 3335	
Det Relay	402561C	8722099	

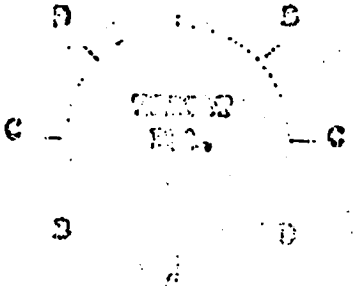
024 0125 60 sec. 145,000 Thrust Vector

SEA Batt check position: ANR 930 Safe/Arm Batt check position: ANR 930

Safe/Arm Relay cycling readings: ANR 930 Det Relay cycling readings: ANR 930

Safe/Arm Inhibit Impedance Readings: OK

Thrust Vector Servo Impedance Readings: THROAT INSERT LOOSE REF McDONNELL MRR #57972



Resistance			
A-B	.6728	A-B	.6727
B-C	.6727	B-C	.6727
C-D	.6727	C-D	.6727
D-B	.6727	D-B	.6727
B-G	4.208	B-G	4.206
	Ave. .6727		

Remarks:

Cox F/M S/N 1460 @ 64°
NTO S/N 3006 .874 @ 20°
MMH S/N 3633

No GRIFICE TAGS

10-16-64 Cell 32 "K" Stand No. 85A Moore

	SOV	2075 10-21	4053579
D.A.T.	Injector		UNK
	Ablative Motor		UNK
	O.M.S. Valve	4075615	8722099
	Fuel Valve	407662	9183335

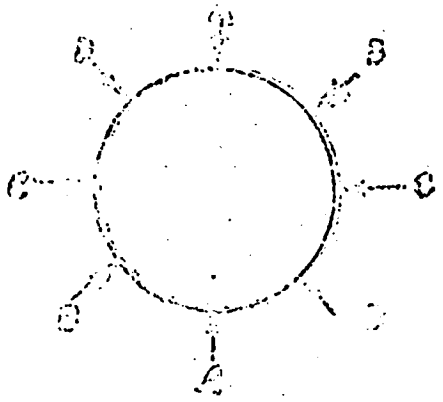
Quantity	Type	Drawing Number	Serial Numbers
.087	START 2214 STOP 2251	145,000	MDC per PARA 6.7 & Table II

TCA Leak Check Performed (ANSO) System Leak Check Performed (ANSO)

O.M.S. Valve Operating Verified (ANSO) Fuel Valve Operating Verified (ANSO)

Pre Test Injector Inspection, Remarks: good

Pre Test Thrust Insert Inspection. Remarks: good



	Fuel		Ox
A.A.	.6727	A.A.	.6775
B.B.	.6728	B.B.	.6762
C.C.	.6727	C.C.	.6882
D.D.	.6728	D.D.	.6772
E.D.	4.208	E.D.	4.202

No Orifice Tags

2927 2860

R-15019-2

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Post test: ① 1st Segment upstream of throat insert cracked 5" A-V" Chip missing. ② Circumferential Ablative seperation at bond area 1" down-stream of throat insert. ③ Several Blisters 5" "D" Ply Ablative Material seperations in TCA. scarfed off Area. ④ Small Amount of Circumferential Glassing on down-stream side of throat insert.
Throat insert cracked at 80% 5 20%

Inspection Complete 10/16/64 (ANSO)

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 207510-401 SHEET 107 OF 171

Reference: MAC SCD 52-52701, Revision F, Figure 12

7.3 Thrust Chamber Assembly No. 3

This subsection specifies the tests which are to be performed on Thrust Chamber Assembly No. 3.

PREPARED BY: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/17		4-18-64		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 108 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.2.1

7.3.1 Pre-Test Inspection - TCA #3

7.3.1.1 Test Procedure

7.3.1.1.1 Verify that the TCA is of the proper configuration, that it has been properly packaged and that it contains no defects such as broken parts, corrosion, damage or deterioration. Also verify that the TCA has passed the acceptance tests of RA0220-348. Only those TCA's meeting the above requirements shall be accepted for DAT.

7.3.1.1.2 Braze propellant valve inlet adapters to the oxidizer and fuel propellant valves per RA0607-009.

7.3.1.1.3 Perform Weight Determination per paragraph 6.6.

PREPARED BY: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE 4-18-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/17				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 109 OF 171

7.3.1.2 Test Data - TCA #3

7.3.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-275		
Rocketdyne Part No.	207510-21	907561	407662
Component Serial No.	1053579	8122099	4123335

7.3.1.2.2 Inspection (reference paragraph 7.3.1.1)

7.3.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, that it had been properly packaged and that it contained no defects such as broken parts, corrosion, damage or deterioration. Also, the TCA records were inspected and it was verified that the TCA had passed the acceptance tests of RA0220-348. YES (Yes or No)

7.3.1.2.2.2 Propellant valve inlet adapters were installed on the propellant valves per paragraph 7.3.1.1.2. YES (Yes or No)

7.3.1.2.2.3 Inspection Remarks

NONE

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64		Eugene Fontaine 8/18/64	Witnessed by ERRICSON 8/18/64
			VERIFIED BY USAF / DATE 4/15/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510-401 SHEET 109 OF 171

7.3.1.2 Test Data - TCA #3

7.3.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	52-52701-275		
Rocketdyne Part No.	207510-21	407561	407663
Component Serial No.	10[illegible]74	8722094	7133385

7.3.1.2.2 Inspection (reference paragraph 7.3.1.1)

7.3.1.2.2.1 The TCA was inspected to insure that it was of the proper configuration, that it had been properly packaged and that it contained no defects such as broken parts, corrosion, damage or deterioration. Also the TCA records were inspected and it was verified that the TCA had passed the acceptance tests of RA0220-348 ~~[illegible]~~ (yes or no).

7.3.1.2.2.2 Propellant valve inlet adapters were installed per Figure 11 and 11A on the propellant valves per paragraph 7.3.1.1.2 Yes (yes or no).

7.3.1.2.2.3 Propellant valve inlet adapters were rotated per Figure 11B after thrust vector tests YES (yes or no). A

7.3.1.2.2.4 Inspection Remarks: NONE 10/12/64 (ANR 815)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 10-6-64	10/12/64	Eugene Fuccini 10/12/64 (ANR 815)	WAIVED BY BOORSTAD (ANR 815) 10/12
			VERIFIED BY USAF / DATE: SEE BELOW

FORM 608-B-39 NEW 6-63

WAIVED BY MDAC INSPECTOR BY TELE CON 10-12-64 (ANR 815)

Rev. A J. D. Montgomery dated 10-6-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST PRE-TEST INSPECTION TEST NO. 207510 SHEET 110 OF 171

7.3.1.2.3 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.
Yes (AMR 7-20) (Yes or No)

The TCA dry weight was 8.44 (AMR 7-20) pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

None (AMR 7-20)

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
EA 4/15/64 E. Adams	7 I Vopc 8-20-64	J.F. Murchison 8/21/64	[illegible] 8/21/64
			VERIFIED BY USAF DATE 8-20-64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-375 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 111 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

7.3.2 Thrust Vector - TCA #3

7.3.2.1 Test Procedure

7.3.2.1.1 Perform thrust vector firing test per paragraph 6.7. Make two 0.25 second pulses without oscillograph instrumentation followed by two 2.75 second duration tests to determine the direction of the thrust vector with respect to the TCA longitudinal axis. The off time between each firing shall be three (3.0) seconds. The TCA shall demonstrate specification performance for the two steady state test firings.

7.3.2.1.2 Reduce data per RAO 220-231 and SEM 4388-4041.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	9/17/64				
CHECKED BY:	DATE				
	9-17-64		9-17-64		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 112 OF 171

7.3.2.2 Test Data - TCA #3

7.3.2.2.1 Component Identification

Component Name SE-7 Rocketdyne Part No. 207510-21

McDonnell Part No. 52-52701-275 Component Serial No. 40535-79

Accumulated Acceptance Test Firing Time, seconds 3 Sec

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	6727	6727
Nozzle Exit Diameter, inches	4.208	4.206

* Thrust Fixture Dim. "A" 10.687

* Thrust Fixture Dim. "K" 6.750

* Misalignment Thrust F_{xu} -.1111

* Misalignment Thrust F_{xL} 8.5

* Misalignment Thrust F_{yu} .27

* Misalignment Thrust F_{yL} -.106

*(Refer to Figure 13)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
J. Ganger 9/17/64	R C C 1-25-65		R L Dane 7/22/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-701 SHEET 113 OF 171

7.3.2.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	10-5-64	10-5-64
Sample Batch Number	10-68	10-66
Sample Temperature, F	64°	71°
Sample Specific Gravity	1.460	874
Met Mil Spec. Requirements (yes or no)	yes	yes

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
J. Canger 10/7/64	2554 10/20/64	Wm. Moore OCT 20 64	WAIVED BY MICHAELIS 10/20/64
			VERIFIED BY USAF / DATE: H. P Braaten 10/9/64

FORM 608-B-39 NEW 6-63

* Written in Error

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET ___ OF ___

IL 5388-6252

Deviation Request:

It is hereby authorized to accept the following deviations from the DAT Specification 207510-401 for 85 lb TCA Unit No. 3.

1. The steady state NTO inlet pressure (321.9 psia) exceeded the specification limit of 285 ± 10 psia.

2. The steady state MMH inlet pressure (316.7 psia) exceeded the specification limit of 287 ± 10 psia.

3. The TCA thrust (85.2 pounds) exceeded the specification limit of 79 ± 4 pounds.

The "out-of-specification" parameters are a result of excessively high facility tank pressures which were based on erroneous facility blowdowns obtained prior to the hot-fire test.

No difficulty was experienced with the test parameters during the IBM adjustments from "site data" to "standard data".

John A. Ganger
Gemini DAT Unit

R. L. Free
MAC Resident
Engineering Rep.

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 114 OF 171

7.3.2.2.3 Thrust Vector Test (reference paragraph 7.3.2.1)

Test Cell Location C.T.L III S 5

Test Cell Number 391

Test Number 024

Test Date 10/9/64

	Site Data		Standard Vacuum	
	Run 1	Run 2	Run I	Run 2
Firing Duration, sec	2.8	2.8		
Accumulated Firing Time, sec	132	16		
Data Slice Number	1	2		
Time of Data Slice	3	5.75		
Ambient Pressure, in. Hg	27.935	27.935		
Ambient Temperature, F	68.	68		
Environmental Pressure, psia	.0128	.0124	0	0
Oxidizer Temperature, F	58	59	70.0	70.0
Fuel Temperature, F	55	57	70.0	70.0

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	R. Cole 1-25-65		R. Dunn 7/22/65
			VERIFIED BY USAF / DATE

FORM 608-8-39 NEW 6-63

~~CONFIDENTIAL~~

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 115 OF 171

7.3.2.2.3 (cont'd)	Site Data Run 1	Site Data Run 2	Standard Vacuum Run 1	Standard Vacuum Run 2	
Oxidizer Inlet Pressure, psia	321.9	320.4	285	285	
Fuel Inlet Pressure, psia	316.7	316.7	287	287	
Oxidizer Flowrate, lbs/sec	.1818	.1811	.1666	.1666	
Fuel Flowrate, lbs/sec	.1126	.1119	.1054	.1052	
Mixture Ratio, O/F	1.62	1.62	1.58	1.58	1.60 ±0.09
Main Thrust F_z lbs	85.2	85.8	78.9	79.6	79 ±4.0
Specific Impulse, sec.	290	293	290	293	280 minimum
Lateral Thrust F_{xL}, lbs	8.5	8.56			
Lateral Thrust F_{yL}, lbs	-.106	-.125			
Lateral Thrust F_{xu}, lbs	-.111	-.0916			
Lateral Thrust F_{yu}, lbs	.270	.350			
Thrust Vector Angle (ϕ) from TCA centerline, degrees	5.62	5.64	5.89	5.89	(5.5±0.5)
Electrical Power, Watts	37.5	39.1			
Oxidizer Valve Voltage, Volts	28.3	28.2			
Fuel Valve Voltage, Volts	28.3	28.1			
Oxidizer Valve Current, Amps.	.692	.690			
Fuel Valve Current, Amps.	.703	.698			
Start Time, Millisecond	32	37			50 maximum
Shutdown Time, Millisecond	72	71			125 maximum

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
8-5-64 E. Adams	1-15-65		7/22/65
			VERIFIED BY USAF DATE

FORM 608-B-39 NEW 6-63

R-15019-2

CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 207510-401 SHEET 116 OF 171

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

7.3.3 DAT Duty Cycle to 270 Seconds - TCA #3

7.3.3.1 Test Procedure

7.3.3.1.1 Perform DAT Duty Cycle Firing Test per paragraph 6.7 and Table II. The TCA shall be fired for a duration of 270 seconds minimum without catastrophic failure. Catastrophic failure is defined in Table II, Note 4.

7.3.3.1.2 Perform decontamination per paragraph 6.8.

7.3.3.1.3 Reduce data per RAO 220-231.

7.3.3.1.3.1 The results of significant data shall include but not be limited to the following:

7.3.3.1.3.1.1 Graphical presentations of temperature versus time for all TCA thermocouple locations.

7.3.3.1.3.1.2 Graphical presentation of thrust versus time.

7.3.3.1.3.1.3 Graphical presentation of chamber pressure versus time.

7.3.3.1.3.1.4 Graphical presentation of oxidizer flowrate versus time.

7.3.3.1.3.1.5 Graphical presentation of fuel flowrate versus time.

7.3.3.1.4 Perform weight determination per paragraph 6.6.

PREPARED BY: J. Ganger	DATE 9/17/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 9-17-64	9-17-64			

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. (MAC 52-52701-275 (NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 207510-401 SHEET 117 OF 171

7.3.3.2 Test Data - TCA #3

7.3.3.2.1 Component Identification

Component Name SE-7

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 40535-79

Accumulated Acceptance Test Firing Time, seconds 3.0 sec

Accumulated Thrust Vector Test Firing Time, seconds 6.0 sec

	Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	.6727	6797
Nozzle Exit Diameter, inches	4.208	4.202

7.3.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	10-12-64	10-12-64
Sample Batch Number	10-188	10-189
Sample Temperature, F	57°	60°
Sample Specific Gravity	1.470	.880
Met Mil Spec. Requirements (Yes or No)	yes	yes

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9/15/64	2554 OCT 20 '64	Mel Mooke OCT 20	WAIVED BY MICHAELIS 10/20/64
			VERIFIED BY USAF / DATE H. P. Burton 10/21/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST FAT DUTY CYCLE TO 270 SECONDS TEST NO. 207510-121 SHEET 118 OF 171

7.3.3.2.3 Duty Cycle Test (reference paragraph 7.3.3.1)

Test Cell Location 39-K-Cell 39

Test Cell Number 39-K

Test Number 087

Test Date 10-16-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
J. Ganger 9/17/64	25 OCT 20	Mel Woodin OCT 20	WAIVED BY MICHAELIS 10/20/64
			VERIFIED BY USAF / DATE: H. P. Brooks 10/26/64

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 2075 10-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 2075 10-401 SHEET 118 OF 171

7.3.3.2.3.1 Pluse No. 1-111 seconds on-time followed by 160 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	112.2		
Accumulated Firing Time, sec	20.8		
Data Slice Number	1		
Time of Data Slice	5.		
Ambient Pressure, in. Hg	27.965		
Ambient Temperature, F	56°		
Environmental Pressure, psia	.026	0	
Environmental Temperature, F	58°		
Oxidizer Temperature, F	60°	70.00	
Fuel Temperature, F	60°	70.00	
Oxidizer Inlet Pressure, psia	288.7	285.00	
Fuel Inlet Pressure, psia	283.7	287.00	
Chamber Pressure, psia	130.2	129.3	
Oxidizer Flowrate, lbs/sec	.1723	.1695	
Fuel Flowrate, lbs/sec	.1056	.1071	
Mixture Ratio, O/F	1.63	1.58	1.60 ±0.09
Main Thrust, lbs.	82.9	82.7	79.0 ±4.0
Specific Impulse, sec.	298.	299.	(280) min.
Electrical Power, Watts	41.5		
Oxidizer Valve Voltage, Volts	29.3		
Fuel Valve Voltage, Volts	28.3		
Oxidizer Valve Current, Amps	.727		
Fuel Valve Current, Amps.	.714		
Start Time, Millisec.	30		50 max.
Shutdown Time, Millisec.	110		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9/17/64	W. Robinson 7-22-65		R L Snee 7/22/66
			VERIFIED BY USAF / DATE

GROUP 4
Downgraded at 3 year intervals; declassified after 12 years
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 207510-401 SHEET 119 OF 171

		Site Data	Standard Vacuum	
7.3.3.2.3.2	Pluse No. 2- 10 seconds on-time followed by 1.0 seconds off-time			
	Firing Duration, sec	10.1		
	Accumulated Firing Time, sec	137		
	Data Slice Number	2		
	Time of Data Slice	9.		
	Ambient Pressure, in. Hg	27.965		
	Ambient Temperature, F	56.		
	Environmental Pressure, psia	.023	0	
	Environmental Temperature, F	250°		
	Oxidizer Temperature, F	60°	70.00	
	Fuel Temperature, F	60°	70.00	
	Oxidizer Inlet Pressure, psia	286.2	285.00	
	Fuel Inlet Pressure, psia	283.7	287.00	
	Chamber Pressure, psia	129.7	129.3	
	Oxidizer Flowrate, lbs/sec	.1712	.1696	
	Fuel Flowrate, lbs/sec	.1052	.1065	
	Mixture Ratio, O/F	1.63	1.59	1.60 ±0.09
	Main Thrust, lbs.	82.1	82.2	79.0 ±4.0
	Specific Impulse, sec.	297.	298.	(280) min.
	Electrical Power, Watts	390		
	Oxidizer Valve Voltage, Volts	28.8		
	Fuel Valve Voltage, Volts	28.0		
	Oxidizer Valve Current, Amps	.695		
	Fuel Valve Current, Amps.	.678		
	Start Time, Millisec.	22		50 max.
	Shutdown Time, Millisec.	98		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 9/17/64	W. Robinson 7-22-65		R L Dee 7/22/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

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R-15019-2

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

~~GROUP-4~~
Downgraded at 12 year intervals; declassified after 12 years

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 207510-401 SHEET 120 OF 171

7.3.3.2.3.3 Pluse No. 6-1.0 seconds on-time followed by 1.0 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	1.0		
Accumulated Firing Time, sec	147		
Data Slice Number	3		
Time of Data Slice	.95		
Ambient Pressure, in. Hg	27.965		
Ambient Temperature, F	56°		
Environmental Pressure, psia	.019	0	
Environmental Temperature, F	Chart pegged above 300°		
Oxidizer Temperature, F	60°	70.00	
Fuel Temperature, F	60°	70.00	
Oxidizer Inlet Pressure, psia	285.2	285.00	
Fuel Inlet Pressure, psia	284.2	287.00	
Chamber Pressure, psia	131.7	131.4	
Oxidizer Flowrate, lbs/sec	.1201	.1690	
Fuel Flowrate, lbs/sec	.1043	.1052	
Mixture Ratio, O/F	1.63	1.61	1.60 ±0.09
Main Thrust, lbs.	82.3	82.4	79.0 ±4.0
Specific Impulse, sec.	300	300	(280) min.
Electrical Power, Watts	39.0		
Oxidizer Valve Voltage, Volts	29.1		
Fuel Valve Voltage, Volts	28.2		
Oxidizer Valve Current, Amps	.6785		
Fuel Valve Current, Amps.	.683		
Start Time, Millisec.	25		50 max.
Shutdown Time, Millisec.	90		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams	W. De Simone 7-22-65		R L Drew 7/22/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

R-15019-2
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 20751 0-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 20751 0-401 SHEET 121 OF 171

7.3.3.2.3.4 Pluse No. 8-0.5 seconds on-time followed by 0.5 seconds off-time	Site Data	Standard Vacuum	
Firing Duration, sec	.5		
Accumulated Firing Time, sec	148		
Data Slice Number	4		
Time of Data Slice	.45		
Ambient Pressure, in. Hg	27.965		
Ambient Temperature, F	56°		
Environmental Pressure, psia	.019	0	
Environmental Temperature, F	Chart paged above 300°		
Oxidizer Temperature, F	52°	70.00	
Fuel Temperature, F	52°	70.00	
Oxidizer Inlet Pressure, psia	283.7	285.00	
Fuel Inlet Pressure, psia	282.2	287.00	
Chamber Pressure, psia	128.5	128.6	
Oxidizer Flowrate, lbs/sec	.1707	.1699	
Fuel Flowrate, lbs/sec	.1054	.1064	
Mixture Ratio, O/F	1.62	1.60	1.60 ±0.09
Main Thrust, lbs.	82.3	82.7	79.0 ±4.0
Specific Impulse, sec.	298	299	(280) min.
Electrical Power, Watts	39.0		
Oxidizer Valve Voltage, Volts	29.1		
Fuel Valve Voltage, Volts	28.3		
Oxidizer Valve Current, Amps	.6785		
Fuel Valve Current, Amps.	.678		
Start Time, Millisec.	23		50 max.
Shutdown Time, Millisec.	110		125 max.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams	W. Wakiman 7-22-65		R. L. Ince 7/22/65
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

R-15019-2

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GROUP-4

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DAT DUTY CYCLE TO 270 SECONDS TEST NO. 207510-401 SHEET 122 OF 171

7.3.3.4 Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.

YES (Yes or No)

The TCA dry weight was 7.86 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

NONE 10-22-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams	Frank Vokes 10/22/64	T. Kaye 10-22-64	WAIVED BY 10 22 64 J. MARVOSSIAN
			VERIFIED BY USAF / DATE 10-22-64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO 207510-401 SHEET ___ OF ___

IL 4388-5410

Deviation Request:

Due to the extreme environmental temperatures encountered in the propellant valve service tests these deviations are hereby authorized. (Reference paragraph 7.3.4).

1. For paragraph 6.1 both propellant valves will be run simultaneously. If the leakage rate is over 2.23 scc He/min the valves will then be run separately.

2. For paragraph 6.5 the response times for both propellant valves will be run prior to the low voltage operations.

Recopied from original request dated 27, October 1964.

James D. Mavrogenis
MAC Engineering

R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5411

Deviation Request:

It is hereby authorized to accept the following deviations:

(1) Reference paragraph 7.3.4.2.9.1 water temperature variation from 195 to 210 (Spec. 200 ±5).

(2) Reference paragraph 7.3.4.2.11 - opening time of .0215 ms for oxidizer valve (Spec. .021 max).

Recopied from original request dated 28, October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

R. Cole
R.Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO 207510-401 SHEET ___ OF ___

IL 4388-5412

Deviation Request:

It is hereby authorized to accept the following deviations for 85# TCA Unit #3.

(1) Isopropyl alcohol will be substituted for ethyl alcohol. (Reference paragraph 7.3.4.)

(2) A Filter (Type F1) will be installed between the TCA and the reservoir when recirculating the isopropl alcohol and distilled water solution. (Reference paragraph 7.3.4.)

Recopied from original request dated 31, October 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

R. Cole
R. Cole
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5413

Deviation Request:

The throat insert on 85 lb TCA Unit #3 was lined with sealing compound to prevent leakage during low environmental temperature propellant valve service life testing.

Recopied from original request dated 2, November 1964.

James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5414

Deviation Request:

In order to complete the 85# TCA (Unit #3) Propellant Valve Service Life Test, sealing compound will be applied between the shell and ablative body on the exit end and around the internal surface of the nozzle area to prevent leakage during the Low Temperature Environmental Test employing isopropyl alcohol and water.

Recopied from original request dated 3, November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-101 SHEET ___ OF ___

IL 4388-5415

Deviation Request:

Conduct the Propellant Valve Electrical Resistance Test per paragraph 6.3 on the fuel and oxidizer valve. For additional information to ascertain the cause of fuel valve failure. (Reference OFR 12981R.)

Recopied from original request dated 5, November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
E. Adams
Gemini DAT-RAT Unit

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET ___ OF ___

IL 4388-5416

Deviation Request:

The Propellant Valve Electrical Resistance Test of paragraph 7.3.4.2.17 will be conducted following the Low Temperature Functional Tests of paragraphs 7.3.4.2.16, 7.3.4.2.18 and 7.3.4.2.19. This out of sequence testing will permit earlier completion of service life testing on the 85# propellant valves.

Recopied from original request dated 5, November 1964.

James D. Mavrogenis
MAC Engineering
12-3-64

E. Adams
Gemini DAT-RAT Unit

IL 4388-5190

INTERNAL LETTER
North American Aviation, Inc.

DATE 10 November 1964

TO Those Concerned
Address

FROM Gemini DAT-RAT Unit
Address D/896-388

SUBJECT Deviation to Gemini DAT TCA Specification 207510-401

REFERENCE (a) Operation and Failure Analysis Report No. 12981R, dated 5 November 1964

Corrective action with respect to reference (a) will be deferred temporarily to permit completion of the subject propellant valve functional test on the oxidizer valve only (reference paragraph 7.3.4.2.19 on page 150) following the 50,000 cycle propellant valve service life test using 85 lb TCA Unit #3 (P/N 207510-21, S/N 4053579).

E. Adams

E. Adams
Gemini DAT-RAT Unit

Approved: R. G. Eide

R. G. Eide
Supervisor
Gemini DAT-RAT Unit

for James D. Mavrogenis

R. Mantler
MAC Engineering

FORM R 18-G-4

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 123 OF 171

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.2.2

7.3.4 Propellant Valve Service Life - TCA #3

7.3.4.1 Test Procedure

7.3.4.1.1 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.

7.3.4.1.2 Perform Propellant Valve Electrical Resistance per paragraph 6.3.

7.3.4.1.3 Perform Propellant Valve Dielectric Strength per paragraph 6.4.

7.3.4.1.4 Perform Propellant Valve Functional per paragraph 6.5.

7.3.4.1.5 Install the TCA in a test setup as shown in Figure 9 . Close all test valves. The environmental temperature shall be room temperature.

7.3.4.1.6 Adjust the regulated GN_2 supply pressure so that 200 ±10 psig is indicated on G_1.

7.3.4.1.7 Open Valve V_1. Adjust the DC power supply to 26 ±1 VDC.

7.3.4.1.8 Activate the cycler. The propellant valves shall each be cycled 5000 times. The 5000 cycles shall consist of 1000 cycles at each of 1, 2, 3, 4, and 5 cycles per second.

Following the above 5000 cycles of operation and each successive five thousand cycles of operation thereafter the propellant valves shall be energized continuously and observation made of Gage G_1 and Gage G_2. The filter elements shall be replaced with clean elements if a difference of 90 psi or greater exists between Gage G_1 and Gage G_2.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	6-29-64	R. Y. Eide	8-12-64		
CHECKED BY:	DATE				
[illegible]	8-12-64				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 124 OF 171

7.3.4.1.9	Reduce the regulated GN_2 supply pressure to zero. Then close Valve V_1. Reduce the DC power supply voltage to zero.
7.3.4.1.10	Remove the TCA from the test setup.
7.3.4.1.11	Repeat paragraph 7.3.4.1.1 and paragraph 7.3.4.1.4.
7.3.4.1.12	Reinstall the TCA in the test setup.
7.3.4.1.13	Fill the reservoir with water leaving a small amount of ullage for expansion due to temperature effects. Open Valve V_1.
7.3.4.1.14	Adjust the reservoir temperature to 200 $\pm$5F. Adjust the TCA environmental temperature to 250 $\pm$5F.
7.3.4.1.15	Adjust the regulated GN_2 supply pressure so that 200 $\pm$10 psig is indicated on Gage G_1. Adjust the DC power supply to 26 $\pm$1 VDC.
7.3.4.1.16	Activate the cycler. The propellant valves shall each be cycled 5000 times. The 5000 cycles at each of 1, 2, 3, 4 and 5 cycles per second.
7.3.4.1.17	Repeat paragraphs 7.3.4.1.9 through 7.3.4.1.13.
7.3.4.1.18	Adjust the reservoir temperature and the TCA environmental temperature to 160 $\pm$5F.
7.3.4.1.19	Adjust the regulated GN_2 supply pressure so that 200 $\pm$10 psig is indicated on Gage G_2. Adjust the DC power supply to 26 $\pm$1 VDC.
7.3.4.1.20	Repeat paragraph 7.3.4.1.16 four times.
7.3.4.1.21	Repeat paragraphs 7.3.4.1.9 through 7.3.4.1.12.

PREPARED BY: E. Adams EA DATE 4/15/64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: DATE 4/17	4-18-64	

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 125 OF 171

7.3.4.1.22 Remove the water from the reservoir and fill the reservoir with a fifty per cent solution of alcohol and water.

7.3.4.1.23 Adjust the regulated GN_2 supply pressure so that 150 ±10 psig is indicated at Gage G_2. Open Valve V_1.

7.3.4.1.24 Energize the propellant valves with 26 ±1 VDC. When the alcohol and water solution appears at the vent de-energize the propellant valves.

7.3.4.1.25 Adjust the reservoir temperature and the TCA environmental temperature to 15 ±5F.

7.3.4.1.26 Repeat paragraph 7.3.4.1.16 four times.

7.3.4.1.27 Repeat paragraphs 7.3.4.1.9 and 7.3.4.1.10.

7.3.4.1.28 Repeat paragraphs 7.3.4.1.1 through 7.3.4.1.4.

PREPARED BY: E. Adams EA DATE 4/15/64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: DATE 4/17	4-18-64	

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 126 OF 171

7.3.4.2 Test Data - TCA #3

7.3.4.2.1 Component Identification

Component Name TCA SE-7

McDonnell Part No. 52-52701-275

Rocketdyne Part No. 207510-21 (ANA 70)

Component Serial No. 4053579 (ANA 70)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	Leon Nelson 10-23-64	J. F. Menchinson 10/23/64 (ANA 70)	WAIVED 1964 (70) J. MAUROGENIS 10-23-64
			VERIFIED BY USAF / DATE: 21MC Mauro 10/23/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 127 OF 171

7.3.4.2.2 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 $^{+10}_{-0}$)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	<.1 scc He/min	<.1 scc He/min

Inspection Remarks

NONE

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 6-29-64 EA 4/15/64	Jean Watson 10/23/64	L. Johnson 10/23/64	WAIVED BY J. MAVROGENIS 10/23/64
			VERIFIED BY USAF DATE R.F. McNown 10/23/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 128 OF 171

7.3.4.2.3 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F).

Resistance A - B

Oxidizer Valve 41.7 ohms (Acceptable per Figure 10, yes or no YES).

Fuel Valve 41 ohms (Acceptable per Figure 10, yes or no YES).

Resistance C - D (1.0 maximum)

Oxidizer Valve .31 ohms

Fuel Valve .29 ohms

Inspection Remarks

NONE.

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams EA 4/15/64	10/23/64	10/23/64	WAIVED BY J. MIHL ROGERS 10/23/64
			VERIFIED BY USAF DATE

FORM 608-B-39 NEW 6-63

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 129 OF 171

7.3.4.2.4 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground	500	55 (A R 9-4)	500	60 (C)
C to Ground	500	72 (A R 9-4)	500	70 (A R 9-4)
A to C	500	17 (A R 9-4)	500	15 (A R 9-4)

Inspection Remarks

NONE (A R 9-4)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	Second Station 10/23/64	L. Jones (A R 9-4) 10/23/64	(A R 9-4) Witnessed by J. MAVICOBINES 10/23/64
			VERIFIED BY USAF / DATE: Zimmerman 10/23/64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L.Cracraft	585586	ENV.LAB.	2061	10-23-64

PART	PART NO.	TYPE OF TEST
85# CAMS TCA UNIT #3	S/N 4053579	PROPELLANT VALVE PRE-SERVICE LIFE FUNCTIONAL

ENVIRONMENTAL TEMPERATURE 70F

OXIDIZER VALVE

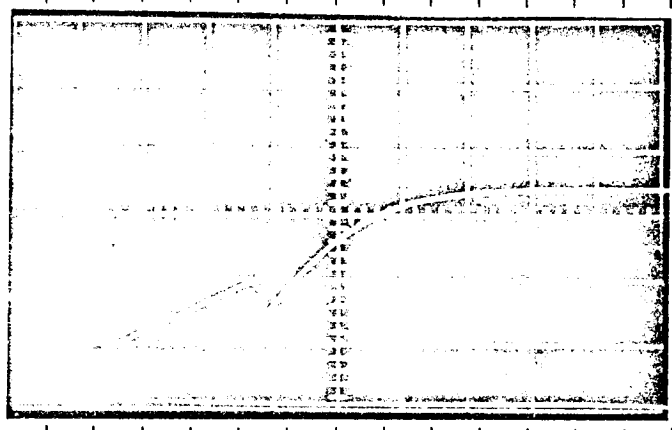
P/N 407561 S/N 8722099

CURRENT TRACE

(OPENING TIME)

Horizontal = .5ms/cm
Vertical = 20mv/cm

Requirement = 0.021 sec/max
Actual = 0.0195 sec

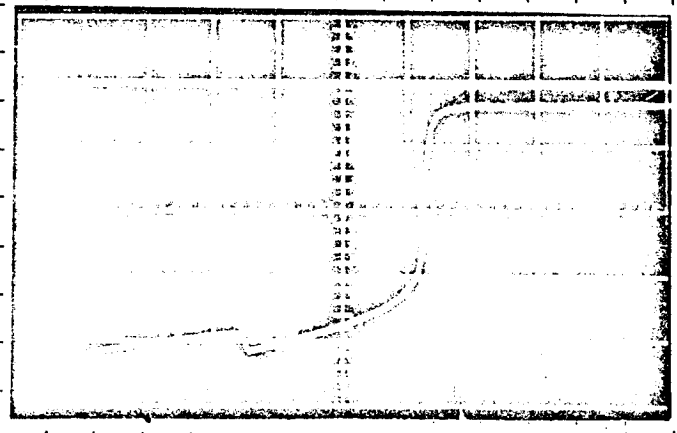


VOLTAGE TRACE

(CLOSING TIME)

Horizontal = 20ms/cm
Vertical = 200mv/cm

Requirement = 0.075 sec/max
Actual = 0.070 sec



ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE_____ OF_____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
L.Cracraft	585586	ENV.LAB.	2061	10-23-64

PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE PRE-SERVICE LIFE FUNCTIONAL

ENVIRONMENTAL TEMPERATURE 70F

FUEL VALVE

P/N 407662 S/N 9183335

CURRENT TRACE

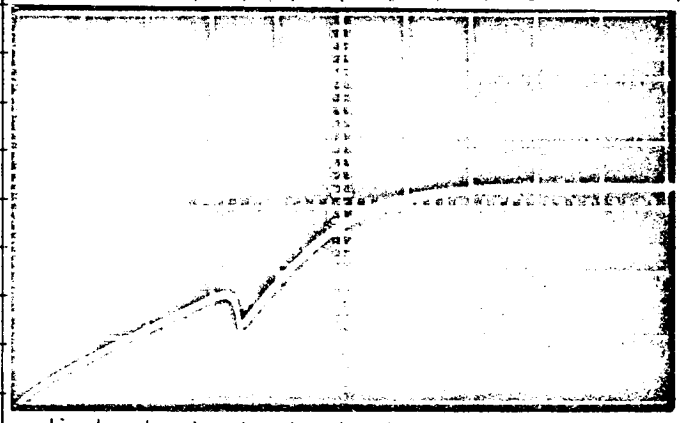
(OPENING TIME)

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Vertical = 20mv/cm

Requirement = 0.025 sec/max

Actual = 0.0175 sec



VOLTAGE TRACE

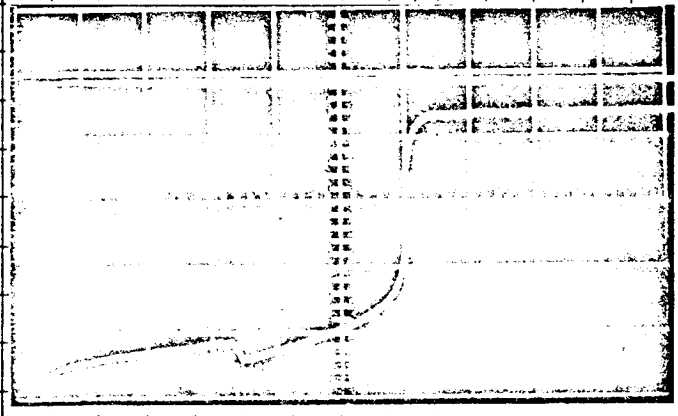
(CLOSING TIME)

Horizontal = 20 ms/cm

Vertical = 200mv/cm

Requirement = 0.075 sec/max

Actual = 0.070 sec



DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 130 OF 171

7.3.4.2.5 Propellant Valve Functional Test (reference paragraph 6.5).

	Oxidizer Valve	Fuel Valve
Response Time		
Ambient Temperature (70 ±10)	70 F (ANR 70)	70° F (ANR 70)
Energizing Voltage (26 ±0.5)	26 VDC (ANR 70)	26 VDC (ANR 70)
Inlet Pressure (300 ±10 for "pull-in")	300 psig (ANR 70)	300 psig (ANR 70)
Opening Time (0.021 maximum)	.019 seconds (ANR 70)	.017 seconds (ANR 70)
Inlet Pressure (zero for "drop-out")	Zero psig (ANR 70)	Zero psig
Closing Time (0.075 maximum)	.070 seconds (ANR 70)	.070 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F (ANR 70)	70 F (ANR 70)
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig (ANR 70)
Opening Voltage (16 maximum)	13.5 VDC (ANR 70)	12 VDC
Inlet Pressure (zero for "drop-out")	Zero psig (ANR 70)	Zero psig
Closing Voltage (1.0 minimum)	1.29 VDC (ANR 70)	1.35 VDC

Inspection Remarks

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	Gene Watson 10-28-64	J. Thurston (ANR 70) 10/23/64	Witnessed J. Flanagan (ANR 70) 10/28/64
			VERIFIED BY USAF / DATE: [illegible] 10/23/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 131 OF 171

7.3.4.2.6 Propellant Valve Service Life Test (reference paragraph 7.3.4.1)

7.3.4.2.6.1

	Oxidizer Valve	Fuel Valve
Environmental Temp. (Room temp.)	70 F	70° F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (5000)	5000 cycles	5000 cycles

Inspection Remarks

NONE

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	Leon Nation 10-23-64	10/23/64	WAIVED BY J. MAVROGENIS 10/23/64
			VERIFIED BY USAF / DATE 23 Oct 64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 132 OF 171

7.3.4.2.7 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 $\pm^{10}_{0}$)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 $\pm^{10}_{0}$)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	ZERO scc He min	ZERO scc He min

Inspection Remarks

NONE 10-24-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64 6/29/64	Leon Nation 10-24-64	J.K. Murchison 10/24/64	Waived By 10-24-64 R.K. Lee
			VERIFIED BY USAF 10/24/64 Robert M. Lyons

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE_____ OF_____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV.LAB.	2061	10-24-64

PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (5,000 Cycles)

ENVIRONMENTAL TEMPERATURE 70F

OXIDIZER VALVE

P/N 407561 S/N 8722099

CURRENT TRACE

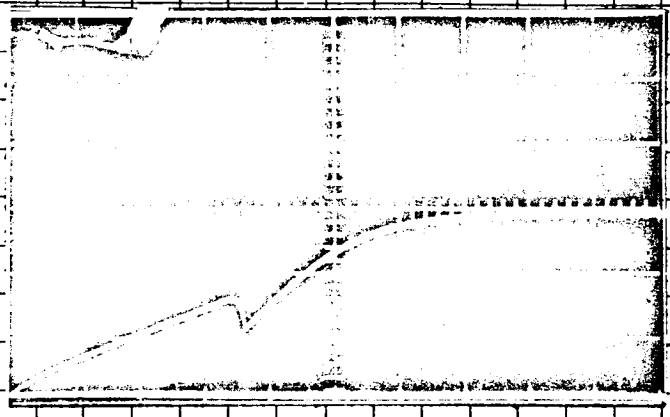
(OPENING TIME)

Horizontal = 5ms/cm

Vertical = 20mv/cm

Requirement = 0.0215 sec/max

Actual = 0.018 sec



VOLTAGE TRACE

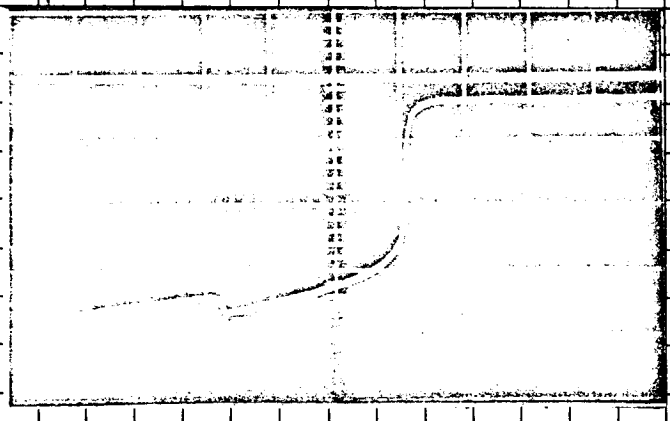
(CLOSING TIME)

Horizontal = 20ms/cm

Vertical = 200mv/cm

Requirement = 0.075 sec/max

Actual = 0.066 sec



R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE_____ OF_____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV.LAB.	2061	10-24-64
PART	**PART NO.**	**TYPE OF TEST**		
85# OAMS TCA UNIT #3	207510-21 S/N 4053979	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (5,000 Cycles)		

ENVIRONMENTAL TEMPERATURE 70F

FUEL VALVE

P/N 407662 S/N 7183358

CURRENT TRACE

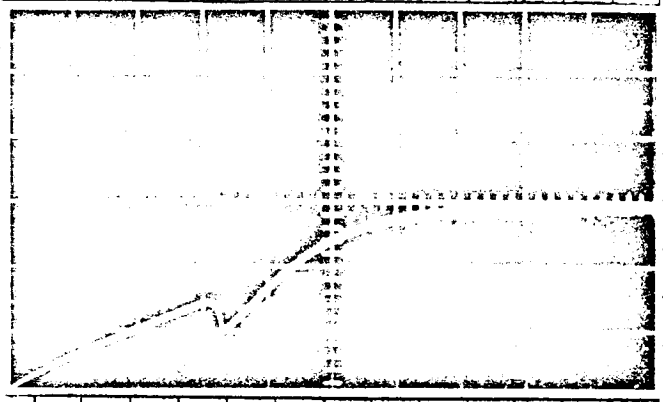
(OPENING TIME)

Horizontal = 5ms/cm

Vertical = 20mv/cm

Requirement = 0.021 sec/max

Actual = 0.0165 sec



VOLTAGE TRACE

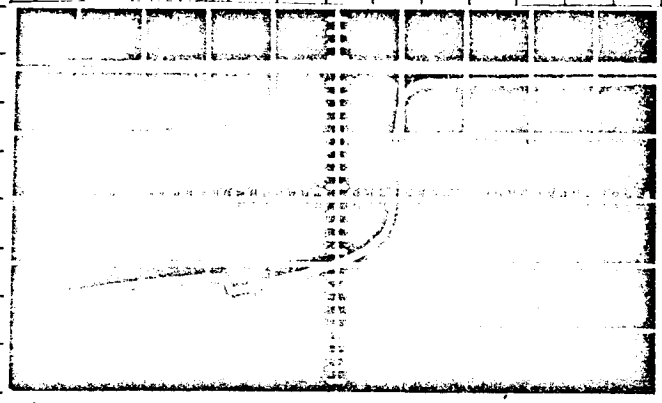
(CLOSING TIME)

Horizontal = 20ms/cm

Vertical = 200mv/cm

Requirement = 0.075 sec/max

Actual = 0.068 sec



Form 600-W-67 New 10-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 85# — PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST: PROPELLANT VALVE SERVICE LIFE — TEST NO. 207510-401 SHEET 133 OF 171

7.3.4.2.8. Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve 407561 / 8722099	Fuel Valve 407662 / 7183355
Response Time		
Ambient Temperature (70 ±10)	70 F	70 F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Time (0.021 maximum)	.018 seconds	.0165 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	.066 seconds	.068 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70 F	70 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	13 VDC	12 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.4 VDC	1.38 VDC

Inspection Remarks

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	Jacobsen 10-24-64	J. F. Murchison 10-24-64	Waived by J. Mavrogenis 10-24-64
			VERIFIED BY USAF / DATE 10/27/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510 SHEET 134 OF 171

7.3.4.2.9 Propellant Valve Service Life Test (reference paragraph 7.3.4.1)

7.3.4.2.9.1

	Oxidizer Valve	Fuel Valve
Environmental Temp. (250 ±5)	250 F (ANR 64)	250 F (ANR 64)
Water Temp. (200 ±5)	(ANR 64) 195 TO 210 F REF DCP # 3	195 TO 210 F (ANR 64)
GN_2 supply pressure (200 ±10)	200 psig (ANR 64)	200 psig (ANR 64)
Number of cycles (5000)	5000 cycles (ANR 64)	5000 cycles (ANR 64)
Total service life cycles (10,000)	10,000 cycles (ANR 64)	10,000 cycles (ANR 64)

Inspection Remarks

AT 616 CYCLES RAN OUT OF WATER, REFILLED WITH WATER & REHEATED TO 200°F AND RAN 384 CYCLES, AT 1681 CYCLES RAN OUT OF WATER, REFILLED WITH WATER & REHEATED TO 200°F AND RAN 319 CYCLES @ 2/SEC; RAN OUT OF WATER AT 3,488 CYCLES, REFILLED WITH WATER AND REHEATED TO 200°F AND RAN 512 CYCLES @ 3 CYCLES/SEC (ANR 64)

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 4/15/64	Leon Nation 10/27/64	(ANR 64) 10/27/64	WAIVED BY J. MAVREEN'S 10/27/64 (ANR 64)
			VERIFIED BY USAF DATE 10/27/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 135 OF 171

73.4.2.10 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure Env. Temp.(250±5)	254 °F	254 °F
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	< .1 scc He/min	< .1 scc He/min

Inspection Remarks

NONE 10-27-64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 6-29-64	10/27/64	10-27-64	WAIVED BY J. MAURICENIS 10/27/64
			VERIFIED BY USAF / DATE 10/27/64

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ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

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LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV.LAB.	2061	10-27-64
PART	**PART NO.**	**TYPE OF TEST**		
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (10,000 Cycles)		

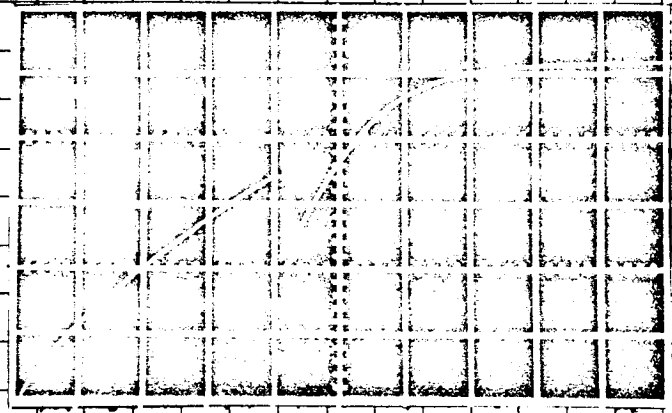
ENVIRONMENTAL TEMPERATURE 250F

OXIDIZER VALVE

P/N 407561 S/N 8722099

CURRENT TRACE

(OPENING TIME)



Horizontal = 5ms/cm

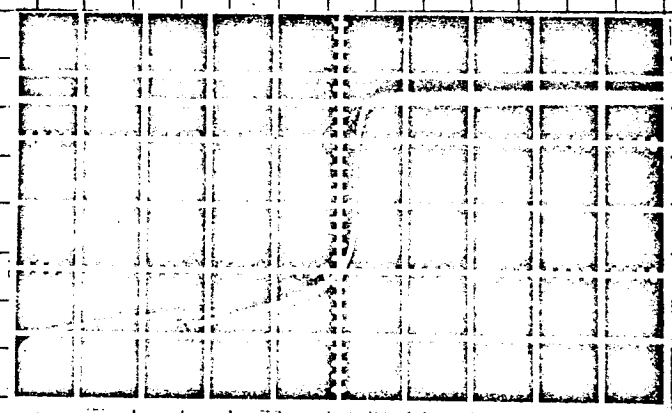
Vertical = 10mv/cm

Requirement = 0.021 sec/max

Actual = 0.0215 sec*

VOLTAGE TRACE

(CLOSING TIME)



Horizontal = 20ms/cm

Vertical = 10mv/cm

Requirement = 0.075 sec/max

Actual = 0.056 sec

* Reference Deviation

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE_____ OF_____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV.LAB.	2061	10-27-64

PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (10,000 Cycles)

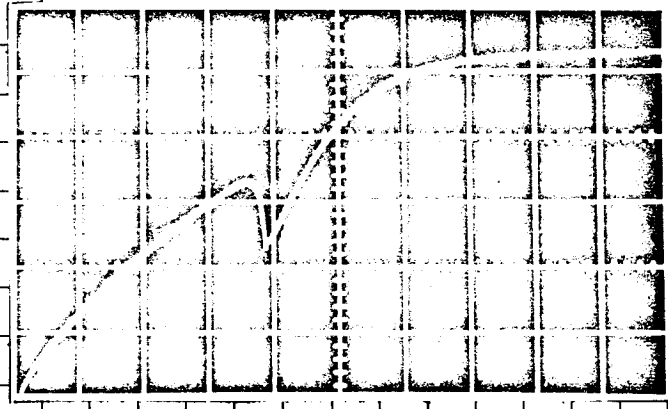
ENVIRONMENTAL TEMPERATURE 250 F

FUEL VALVE

P/N 407662 S/N 7183358

CURRENT TRACE

(OPENING TIME)



Horizontal = 5ms/cm

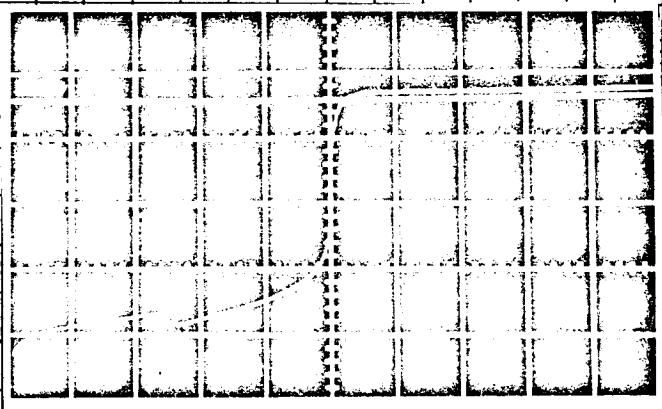
Vertical = 10mv/cm

Requirement = 0.021 sec/max

Actual = 0.0195 sec

VOLTAGE TRACE

(CLOSING TIME)



Horizontal = 20ms/cm

Vertical = 10mv/cm

Requirement = 0.075 sec/max

Actual = 0.055 sec

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21-401

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510 SHEET 136 OF 171.

7.3.4.2.11 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Env. Temperature (250 ±5)	250 F	250° F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig REF DCP # 4	300 psig
Opening Time (0.021 maximum)	.0215 seconds	.0195 seconds
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Time (0.075 maximum)	.056 seconds	.055 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	78° F	78° F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	12.5 VDC	12.4 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.4 VDC	1.45 VDC

Inspection Remarks NICKIE.

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	10/28/64	10/28/64	WAIVE 134 I. MAY ROGERS 10/28/64
			VERIFIED BY USAF / DATE: 10-28-64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 137 OF 171

7.3.4.2.12 Propellant Valve Service Life Test (reference paragraph 7.3.4.1)

7.3.4.2.12.1	Oxidizer Valve	Fuel Valve
Environmental Temp. (160 ±5)	160 F	160 F
Water Temp. (160 ±5)	160 F	160 F
GN_2 supply pressure (200 +10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (15,000)	15,000 cycles	15,000 cycles

Inspection Remarks

NONE $\Delta P = 26$ PSI

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	10/28/64	M. J. Fogarty 10/28/64	WAIVED BY MACRR J. MAVROGENIS 10/08/64
			VERIFIED BY USAF / DATE 10/28/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 138 OF 171

7.3.4.2.12.2

	Oxidizer Valve	Fuel Valve
Environmental Temp. (160 ±5)	155-160 F	155 TO 160 F
Water Temp. (160 ±5)	155-160 F	155 TO 160 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (20,000)	20,000 cycles	20,000 cycles

Inspection Remarks

Δp = 30 PSI - OK

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	10/24/64	M. J. Fogarty 10/24/64	WAIVED BY A. L. FRANZ 10/24/64
			VERIFIED BY USAF / DATE 10/24/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 139 OF 171

7.3.4.2.12.3

	Oxidizer Valve	Fuel Valve
Environmental Temp. (160 ±5)	155-160 F	155-160 F
Water Temp. (160 ±5)	155-160 F	155-160 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (25,000)	25,000 cycles	25,000 cycles

Inspection Remarks

10-29-64 1,649 CYCLES COMPLETED

TOTAL SERVICE LIFE CYCLES, 21,649 CYCLES

ΔP = 38 PSI

PREPARED BY DATE	PEREORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams EA 4/15/64	W. F. Kaiser 10/30/64	W. J. Fogarty 10/30/64	WAIVED BY R. L. FIELDS 10/30/64
			VERIFIED BY USAF DATE R. L. Fields 10/30/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 140 OF 171

7.3.4.2.12.4

	Oxidizer Valve	Fuel Valve
Environmental Temp. (160 ±5)	160 F	160 F
Water Temperature (160 ±5)	158 F	158 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (30,000)	30,000 cycles	30,000 cycles

Inspection Remarks

$\Delta p = 26$ PSI.

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 4/15/64	H E Wallace 10/30/64	M. J. Fogarty 10/30/64	WAIVED BY R. L. FERRY 10/30/64
			VERIFIED BY USAF DATE 10/30/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 141 OF 171

7.3.4.2.13 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure Env. Temp. (160±5)	160 F	160 F
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	≤0.1 scc He/min	ZERO scc He/min

Inspection Remarks

None

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 6-29-64 EA 4/15/64	H. Wallace 10-30-64	C. Lamb 10-30-64	R. L. FREE 10-30-64
			VERIFIED BY USAF / DATE 10-30-64

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV.LAB.	2061	10-31-64

PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (30,000 Cycles)

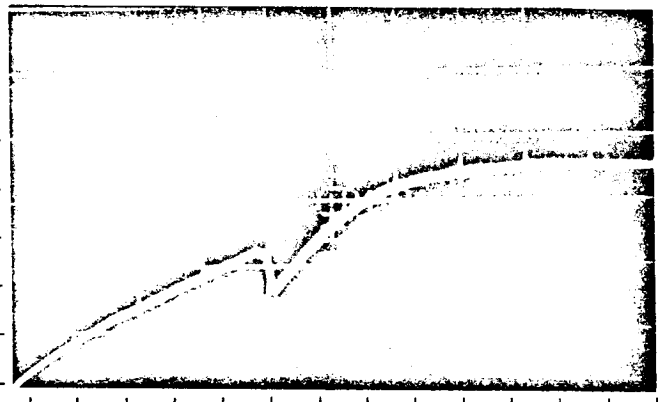
ENVIRONMENTAL TEMPERATURE 160F

OXIDIZER VALVE

P/N 407561 S/N 8722099

CURRENT TRACE

(OPENING TIME)

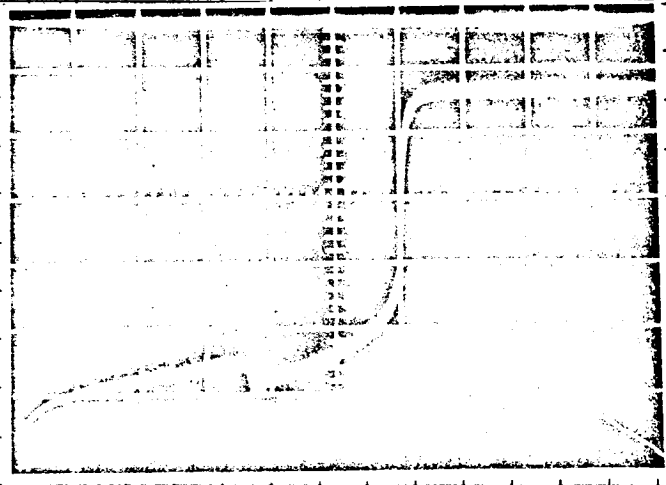


Horizontal = 5 ms/cm
Vertical = 20 mv/cm

Requirement = 0.020 sec/max
Actual = 0.0205 sec

VOLTAGE TRACE

(CLOSING TIME)



Horizontal = 20 ms/cm
Vertical = 200 mv/cm

Requirement = 0.075 sec/max
Actual = 0.075 sec

R-15019-2

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE_____ OF_____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV LAB	2061	10-31-64

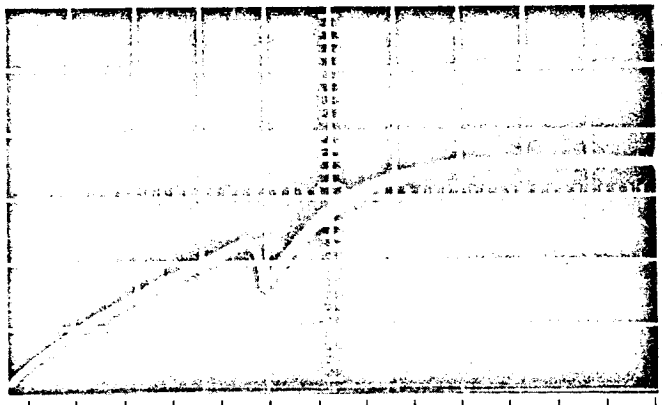
PART	PART NO.	TYPE OF TEST
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (30,000 Cycles)

ENVIRONMENTAL TEMPERATURE 160F

FUEL VALVE

P/N 407662 S/N 7183358

CURRENT TRACE
(OPENING TIME)



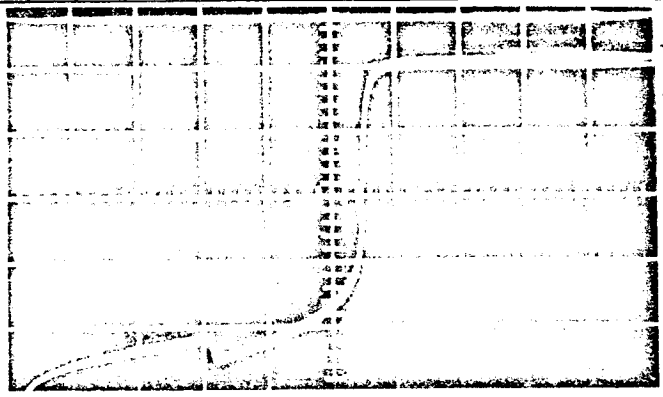
Horizontal = 5ms/cm

Vertical = 20mv/cm

Requirement = 0.021 sec/max

Actual = 0.020 sec

VOLTAGE TRACE
(CLOSING TIME)



Horizontal = 20ms/cm

Vertical = 200 mv/cm

Requirement = 0.075 sec/max

Actual = 0.064 sec

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME: THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST: PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 142 OF 171

7.3.4.2.14 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Env. Temperature (160 ±5)	160° F	160° F
Energizing Voltage (26 ±0.5)	26 VDC	26 VDC
Inlet Pressure (300 +10 for "pull-in")	300 psig	300 psig
Opening Time (0.021 maximum)	.0205 seconds	.020 seconds
Inlet Pressure (zero for "drop-out")	0 psig	0 psig
Closing Time (0.075 maximum)	.075 seconds	.064 seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	71 F	71 F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	300 psig
Opening Voltage (16 maximum)	13.5 VDC	13.7 VDC
Inlet Pressure (zero for "drop-out")	ZERO psig	ZERO psig
Closing Voltage (1.0 minimum)	1.0 VDC	1.2 VDC

Inspection Remarks

NONE 10/31/64

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL (WAIVED) BY / DATE
E. Adame 4/15/64	H. E. Wallace 10/31/64	A. Simon 10/31/64	L. MAURICE EVANS 10/31/64
			VERIFIED BY USAF / DATE: 10/31/64

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. {MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 143 OF 171

7.3.4.2.15 Propellant Valve Service Life Test
(reference paragraph 7.3.4.1)

7.3.4.2.15.1		Oxidizer Valve	Fuel Valve
	Environmental Temp. (15 ±5) *	15 F	15 F
	Alcohol and water temp. (15 ±5)	15 F	15 F
	GN_2 supply pressure (200 ±10)	200 psig	200 psig
	Number of cycles (5000)	5000 cycles	5000 cycles
	Total service life cycles (35,000)	35,000 cycles	35,000 cycles

Inspection Remarks * REF. DCR #5

* REF. IL. DTD. 11/2/64 & 11/3/64

ΔP = 35 PSI

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	H.E. Wallace 11/4/64	M.J. Fogarty 11/4/64	WAIVED BY J. HAVROGANS 11/4/64
			VERIFIED BY USAF / DATE: 11/4/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 144 OF 171

7.3.4.2.15.2

	Oxidizer Valve	Fuel Valve
Environmental temp. (15 ±5)	15 F (ANR 160)	15 F
Alcohol and water temp. (15 ±5)	15 F (ANR 160)	15 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles (ANR 160)	5000 cycles (ANR 160)
Total service life cycles (40,000)	40,000 cycles (ANR 160)	40,000 cycles (ANR 160)

Inspection Remarks

ΔP = 40 PSI (ANR 160)

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 4/15/64	K. C. Wallace 11/4/64	D. J. Fogarty 11/4/64 (ANR 160)	WAIVED BY J. NAUROCKI 11/4/64 (ANR 330)
			VERIFIED BY USAF DATE 11/4/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510 SHEET 145 OF 171

7.3.4.2.15.3

	Oxidizer Valve	Fuel Valve
Environmental temp. (15 ±5)	15 F	15 F
Alcohol and water temp. (15 ±5)	15 F	15 F
GN_2 supply pressure (200 +10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (45,000)	45,000 cycles	45,000 cycles

Inspection Remarks

ΔP = 40 PSI

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 4/15/64	W E Wallace 11/5/64	M. J. Fogarty 11/5/64	WAIVED BY R. L. FRAIE 11/6/64
			VERIFIED BY USAF DATE 11/5/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 146 OF 171

7.3.4.2.15.4

	Oxidizer Valve	Fuel Valve
Environmental test (15 ±5)	15 F	15 F
Alcohol and water temp. (15 ±5)	15 F	15 F
GN_2 supply pressure (200 ±10)	200 psig	200 psig
Number of cycles (5000)	5000 cycles	5000 cycles
Total service life cycles (50,000)	50,000 cycles	50,000 cycles

Inspection Remarks

ΔP = 42 PSI

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams EA 4/15/64	11/5/64	11/5/64	WAIVED BY R. L. FREITAG 11/5/64
			VERIFIED BY USAF / DATE 11/5/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 147 OF 171

7.3.4.2.16 Propellant Valve Proof Pressure and Leakage Test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure Env. Temp.(15-5)	15 F	15 F
Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (3 minimum)	3.0 minutes	3.0 minutes
Leakage Voltage (26±0.5)	26 VDC	26 VDC
Inlet Pressure (500 +10 -0)	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	ZERO scc He/min	ZERO scc He/min

Inspection Remarks

NONE

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 6-29-64 EA 4/15/64	H.E. Wallace 11/5/64	M. J. Fogarty 11/5/64	WAIVED BY R.L. FREE 11/5/64
			VERIFIED BY USAF DATE C.H. McManus 11/5/64

FORM 608-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 148 OF 171

7.3.4.2.17 Propellant Valve Electrical Resistance Test (reference paragraph 6.3)

Environmental Temperature 68 (ANR 921) (70 ±10F).

Resistance	A - B	
Oxidizer Valve	41.8 (ANR 921) ohms	(Acceptable per Figure 10, yes or no YES (ANR 921))
Fuel Valve	41.2 (ANR 921) ohms	(Acceptable per Figure 10, yes or no YES (ANR 921))
Resistance	C - D (1.0 maximum) (ANR 921)	
Oxidizer Valve	.36 ohms	
Fuel Valve	.05 (ANR 921) ohms	

Inspection Remarks

NONE (ANR 921)

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	11-5 64	(ANR 921)	(ANR 921)
			VERIFIED BY USAF / DATE

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 149 OF 171

7.3.4.2.18 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 +10 -0	Current Microamps 500 max.	Voltage Volts 500 +10 -0	Current Microamps 500 max.
A to Ground (AN 160)	500	* 140 (AN 160)	** 200	** 4000 (AN 160)
C to Ground (AN 160)	500	70 (AN 160)	500	57 (AN 160)
A to C (AN 160)	500	48 (AN 160)	500	57 (AN 160)
Env. Temp.(15±5)	15 F (AN 160)		15 F (AN 160)	

Inspection Remarks: * A TO GROUND - ARCING
** WITH 200 VAC. APPLIED BETWEEN PLN B TO GND. CURRENT LEAKAGE WAS 4000 MICROAMPS S/B 500 MAX. REF. PARA. 6.4 (AN 160) REF. DCP #6

PREPARED BY DATE	PERFORMED BY DATE	WITNESSED FOR NAA DATE	CERTIFIED FOR McDONNELL DATE
E. Adams 4/15/64	11/5/64	* 11/5/64	WAIVED BY J HAURO 11/5/64 (AN 160)
			VERIFIED BY USAF DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY	EWR NO.	FACILITY	PHONE	DATE
F.Pope	585586	ENV LAB.	2061	11-12-64
PART	**PART NO.**	**TYPE OF TEST**		
85# OAMS TCA UNIT #3	207510-21 S/N 4053579	PROPELLANT VALVE SERVICE LIFE FUNCTIONAL (50,000 Cycles)		

ENVIRONMENTAL TEMPERATURE 15F

OXIDIZER VALVE

P/N 407561 S/N 8722099

CURRENT TRACE

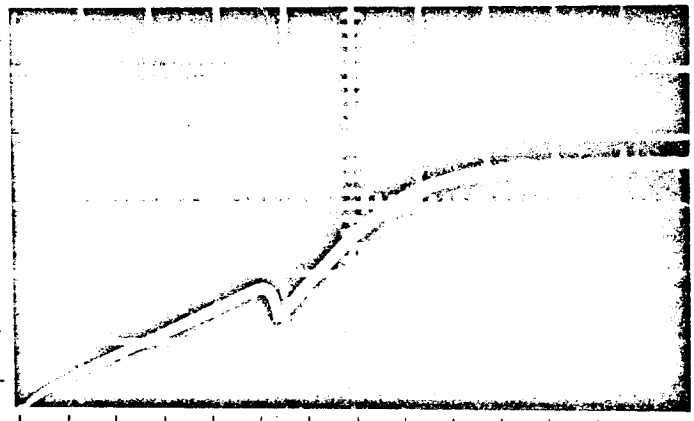
(OPENING TIME)

Horizontal = 5ms/cm

Vertical = 20mv/cm

Requirement = 0.021 sec/max

Actual = 0.020 sec



VOLTAGE TRACE

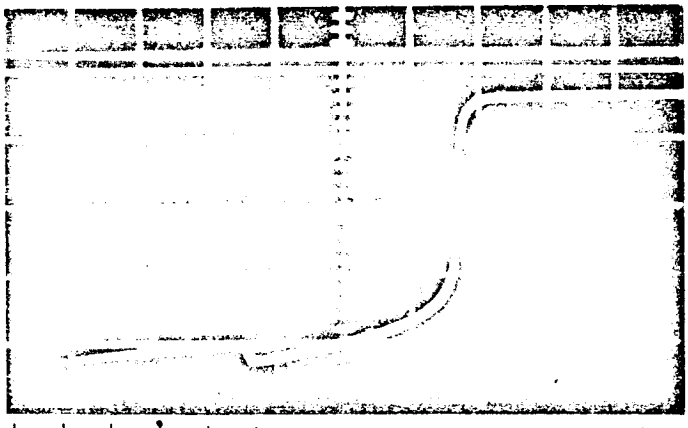
(CLOSING TIME)

Horizontal = 20ms/cm

Vertical = 200mv/cm

Requirement = 0.075 sec/max

Actual = 0.072 sec



R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO. 207510-401 SHEET 150 OF 171

7.3.4.2.19 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Env. Temperature (15 ±5)	15° F	DNA F
Energizing Voltage (26 +0.5)	26 VDC	VDC
Inlet Pressure (300 ±10 for "pull-in")	300 psig	psig
Opening Time (0.021 maximum)	.020 seconds	seconds
Inlet Pressure (zero for "drop-out")	0 psig	psig
Closing Time (0.075 maximum)	.072 seconds	DNA seconds
Low Voltage Operation		
Ambient Temperature (70 ±10)	70° F	DNA F
Inlet Pressure (300 ±10 for "pull-in")	300 psig	psig
Opening Voltage (16 maximum)	14.1 VDC	VDC
Inlet Pressure (zero for "drop-out")	0 psig	psig
Closing Voltage (1.0 minimum)	1.7 VDC	DNA VDC

* REF IL #4388-5190 DTD 10-NOV-64

Inspection Remarks

PREPARED BY / DATE	PERFORMED BY / DATE	WITNESSED FOR NAA / DATE	CERTIFIED FOR McDONNELL / DATE
E. Adams 4/15/64	11/12/64	E. Strode 11/12/64	Waived By R E Fiec 11/12/64
			VERIFIED BY USAF / DATE 11/12/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 401

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO 207510- SHEET 151 OF 171

Reference:	MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20
7.3.5	Disassembly and Inspection
7.3.5.1	Test Procedure
7.3.5.1.1	Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.
7.3.5.1.2	Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 7. All cutting shall be done by saw. C
7.3.5.1.3	Separate the propellant valves from the mounting bracket. C
7.3.5.1.4	Section the TCA by cutting along line C-D-E as depicted in Figure 14.
7.3.5.1.5	Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatability, corrosion, broken parts and impending failure.
7.3.5.1.6	After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C
7.3.5.1.7	Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407661 (Fuel Seat Assembly P/N 407660) shall not be removed at this time. C
7.3.5.1.8	Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish C

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole					
CHECKED BY:	DATE				
[signature]	11-18-64	[signature]	11-18-64		

FORM 608-B-38 NEW 6-63

Rev. C [signature] Date 11/18/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 151 OF 171

(cont'd)	this shall be removed. The filter assembly P/N 5-28139-T1 shall not be removed at this time.	C
7.3.5.1.9	Remove, bag and identify the seat assembly.	
7.3.5.1.10	Remove, bag and identify the armature P/N 407564.	
7.3.5.1.11	Remove, bag and identify the spring P/N 406816.	
7.3.5.1.12	Remove, bag and identify the filter assembly.	
7.3.5.1.13	Bag and identify the solenoid assembly.	
7.3.5.1.14	Repeat 7.3.5.1.7 thru 7.3.5.1.13 for the fuel propellant valve.	C

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole		B. Heide	11-18-64		
CHECKED BY:	DATE				
J. Sanger	11-18-64				

FORM 608-B-38 NEW 6-63

Rev. C J. D. Mangeno Date 11/18/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 152 OF 171

7.3.5.2 Post Test Inspection Data - TCA #1

7.3.4.2.1 Component Identification

Component Name TCA

McDonnell Part No. SNA52-52701-275

Rocketdyne Part No. 207510-21

Component Serial No. 4053579

7.3.5.2.2 Preliminary Inspection (Reference paragraph 7.3.5.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows: EXIT END PAINTED BLUE UP TO APPROX 1" FROM THE THROAT FROM THERE IT IS PAINTED RED INCLUDING THE THROAT EXIT APPEARS TO HAVE NUMEROUS DELAMINATIONS. THROAT HAS 1 LARGE CRACK THE REST OF UNABLE ON THROAT CANNOT BE DETERMINED BECAUSE OF PAINT ON THROAT LINERS HAVE SMALL CRACKS. FUEL VALVE IS NOT ON TCA.

7.5.5.2.3 Disassembly and Inspection (Reference paragraph 7.3.5.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows: COMBUSTION CHAMBER HAS A BLUE SUBSTENCE SHEARED OVER APPROX. 75% OF ITS AREA. COMBUSTION CHAMBER HAS A "RUBBER LIKE" SUBSTENCE BUILT UP ON APPROX. 30% OF THE AREA OF THE THROAT INSERT AND EXTENDING APPROX 3" BEYOND THE THROAT INSERT. THROAT HAS TWO DEEP VERTICLE CRACKS EXTENDING ITS ENTIRE LENGTH AND LOCATED APPROX 1½" APART THE 1ST AND 5TH LINERS (FROM EXIT END) ARE CRACKED. HALF OF THE 4TH AND 5TH LINERS (FROM EXIT END) ARE MISSING. THE ABLATIVE HAS MULTIPLE INNER LAMINAR DELAMINATIONS THROUGH OUT ITS ENTIRE PROFILE. THE ASBESTOS AND GLASS ROVING HAS DELAMINATIONS.

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
T. Kniffin	8-5-64	T.S.4.2.1 / 7.3.5.2.2		Gary L Magdaleno	5/9/65	WAIVED BY SCOTT TE C. Graham	5-24-65
						VERIFIED BY USAF	DATE 1-JUNE-65

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 1521 OF 171

7.3.5.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.3.5.1.7 thru 7.3.5.1.13). C

The propellant valves were disassembled and all parts called for were bagged and identified YES (yes or no).

OXID. VALVE DISASSEMBLED ONLY. FUEL VALVE REMOVED PER OFR ACTION, REF EWR #735 #3 NOTE b.

NUMEROUS SCRATCHES OBSERVED ON ARMATURE & SOLENOID BORE.

FILTER NOT REMOVED BECAUSE NOT MACHINED

FILTER RE MACHINED AND HAS BEEN REMOVED (6/9/65)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
P. Cole D.C.	11-20-64	R. F. Burke (A 807-6)	6/8/65	[illegible]	6/9/65	Deviation waived by	6/5/65
						VERIFIED BY USAF	DATE
						A. J. Minille	6/9/65

FORM 608-B-39 NEW 6-63
Rev C J.D. Manager Date 11-20-64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 5252701-275 / NAA 207510-21

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO 207510-401 SHEET 153 OF 171

TABLE I

MEASUREMENT	RANGE	(3) PRECISION	(1) RESPONSE (SEC)	RECORDER	
Main Thrust (5)	0-120 lb	B(±0.5%)*	1 ±.25	Null Balance	B
Main Thrust (2) (5)	0-120 lb	Y**	0.001	Oscillograph	
Oxidizer Inlet Pressure (4)	0-500 psig	C(±1.0%)	1 ±.25	Null Balance	
Oxidizer Inlet Pressure (4)	0-500 psig	Y**	0.001	Oscillograph	
Fuel Inlet Pressure (4)	0-500 psig	C(±1.0%)	1 ±.25	Null Balance	
Fuel Inlet Pressure (4)	0-500 psig	Y**	0.001	Oscillograph	
Chamber Pressure (4) (5)	0-200 psig	B(±0.5%)	1 ±.25	Null Balance	
Chamber Pressure (4) (5)	0-200 psig	Y***	0.001	Oscillograph	
Oxidizer Flowmeter Temperature (5)	0-300F	D(±5.0F)		Null Balance	
Oxidizer Inlet Temperature (5)	0-300F	D(±5.0F)		Null Balance	
Fuel Flowmeter Temperature (5)	0-300F	D(±5.0F)		Null Balance	
Fuel Inlet Temperature (5)	0-300F	D(±5.0F)		Null Balance	
Oxidizer Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	1 ±.25	Null Balance	
Oxidizer Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	0.001	Oscillograph	
Fuel Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	1 ±.25	Null Balance	
Fuel Flowrate (5)	0.50-2.0 gpm	B(±0.5%)*	0.001	Oscillograph	
Oxidizer Valve Current	0-1.0 amp	Y	0.001	Oscillograph	
Fuel Valve Current	0-1.0 amp	Y	0.001	Oscillograph	
Oxidizer Valve Voltage	0-40 volts	Y**	0.001	Oscillograph	
Fuel Valve Voltage	0-40 volts	Y**	0.001	Oscillograph	
Local Ambient Pressure	21-40 in Hg	Y		Barometer	
Environmental Pressure (Fine)	0.02-0.20 psia	C(±1.0%)	1 ±.25	Null Balance	
Environmental Pressure (Fine)	0.02-0.20 psia	C(±1.0%)	1 ±.25	Null Balance	
Environmental Pressure (Coarse)	0.02-15.0 psia	C(±1.0%)	1 ±.25	Null Balance	
Environmental Temperature	0-300F	D(±5.0F)		Null Balance	
TCA Wall Temperature (3 Places)(8)	0-1000F	D(±20 F)		Null Balance	C
TCA Core Temperature (7)	0-1000F	D(±20 F)		Null Balance	B
Lateral Thrust, F_{xu} (6)	-10.0to+10.01b	Y****	1 ±.25	Null Balance	
Lateral Thrust, F_{xL} (6)	-10.0to+10.01b	Y****	1 ±.25	Null Balance	
Lateral Thrust, F_{yu} (6)	-10.0to+10.01b	Y****	1 ±.25	Null Balance	
Lateral Thrust, F (6)	-10.0to+10.01b	Y****	1 ±.25	Null Balance	A

PREPARED BY: DATE	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
J. A. Ganger 9/26/64	R. Heide 10-8-64	
CHECKED BY: DATE		
O. C. C. 10-8-64		

FORM 608-B-38 NEW 6-63

REVISION C J. D. Mangione DATED 10-9-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21
NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO 207510-401 SHEET 154 OF 171

TABLE I
(cont'd)

MEASUREMENT	(1) RESPONSE (SEC)	RECORDER	
Start and Cutoff, Pip	0.001 1.0 Max.	Oscillograph and Time Sequence	A
Oscillograph Drive, Pip	1.0 Max	Time Sequence	D
DIGR Drive, Pip	1.0 Max	Time Sequence	

NOTES:

(1) Response is defined as the time required for the measurement recording system to travel from zero to full scale.

(2) Trace full scale deflection shall be 3.0 inch minimum except for time sequence.

(3) Letters designate instrumentation precision category per RA0201-050.

(4) Ranges shall be increased 100 per cent for DAT Duty Cycle to minimum duration and Burst Pressure Firing Tests.

(5) A single measuring transducer may be utilized to satisfy the requirements of more than one "bit" of information under the following circumstances:
   A) Signal of one parameter is split to satisfy the requirements for more than one type of recorder.
   B) Transducer is physically located to satisfy the requirements of more than one parameter.

(6) Thrust Vector Tests only. A

(7) Cape Cycle Tests only. B

(8) Deleted for Thrust Vector Tests only. C

PREPARED BY: J. Ganger DATE 9/17/64	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: R W Deming Jr. DATE 9-17-64	S J Eide 9-17-64	

FORM 608-B-38 NEW 6-63

REVISION D J. D. Mangrum Dated 10/23/64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST MINIMUM INSTRUMENTATION REQUIREMENTS - HOT FIRE TESTS TEST NO. 207510-401 SHEET 154 OF 171

NOTES: (cont'd)

TABLE I
(cont'd)

* **Thrust:**
DIGR precision shall be "C(±1.0%)" for Thrust Vector Tests only. B

* **Flowrates:**
"B" precision is required only: 1) on the OSC. when turbine type flowmeters are used ; 2) on the DIGR when drag body type flowmeters are used. For drag body type flowmeters, a three-step transfer calibration shall be recorded on the oscillograph and DIGR at the following pre and post test bleed flowrates; 0.103, 0.138 and 0.173 lb/sec. The Osc. deflections at nominal test flowrates shall be 2.5 inches minimum. For turbine type flowmeters, the DIGR precision shall be "C(±1.0%)". A

** Thrust:
Perform a pre test multi-step calibration and record on the oscillograph at the following simulated thrusts; 0,6,12,24,60,72,84,96,108, 120,108,96,84,72,60,24,12,6 and 0. This shall be followed by a pre and post test one-step calibration (verification).

** Inlet Pressures:
Perform a multi-step transfer calibration (referenced to the DIGR) and record on the oscillograph at the following inlet pressures ±25 psi; 150 and 250 psig, and test lock-up inlet pressure. A post test one-step transfer calibration shall be recorded at the test lock-up inlet pressure.

** Valve Voltages:
Perform a multi-step calibration and record on the oscillograph at the following voltages ±1 volt; 22, 30 and 26. A post test one-step calibration shall be recorded at 26 ±1 volt.

*** Perform a pre and post test Chamber Pressure standardization and record on the oscillograph.

**** Perform a multi-step calibration and record on the DIGR at the following simulated lateral thrusts; 0, 1.5, 3, 4.5, 6, 4.5, 3, 1.5 and 0 lb/load cell. This shall be followed by a pre and post test one-step calibration (verification). A

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
J. Ganger	9/17/64				
CHECKED BY:	DATE				
R W Dinnie Rg	9-17-64		9-17-64		

FORM 608-B-38 NEW 6-63

Revision B J. D. Morrison Dated 9-28-64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 207510-401 SHEET 155 OF 171

TABLE II

PULSE NO.	ON TIME(SEC.)	OFF TIME(SEC)	(1) TOTAL ON(SEC)	ELAPSED TIME(MIN.)
1	111	160	127	4.52
2	10	1	137	4.70
3	5	1	142	4.80
4	2	2	144	4.87
5	1	2	145	4.92
6	1	1	146	4.95
7	0.5	3	146.5	5.00
8 (2)	0.5	0.5	147	5.17
9 (3)	123		270	7.22
10 (4) - to catastrophic failure				

(1) Includes 10 seconds of calibration firing time and 6 seconds of simulated launch site firing time.

(2) The TCA shall demonstrate specification performance for an accumulative firing time, including calibration and simulated launch site firing time of 147 seconds minimum. TCA skin temperature shall not exceed 500° F.

(3) The TCA shall demonstrate operation without catastrophic failure for an accumulative firing time of 270 seconds minimum.

(4) Pulse number 9 is extended without pause until catastrophic failure occurs.

Catastrophic chamber failure is defined as a condition in which further operation of the TCA would endanger the spacecraft or crew. Specifically it shall include:

(a) Lack of the capability to stop propellant flow,
(b) Any flow or leakage of propellants or products of combustion from locations other than the TCA exit,

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
E. Adams	4/15/64				
CHECKED BY:	DATE				
H Segue	4-18-64		4-18-64		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 -401 156 171

NAME OF TEST DESIGN APPROVAL TEST DUTY CYCLE TEST NO. 207510 SHEET ___ OF ___

TABLE II
(cont'd)

(c) Temperature in excess of 700 F at any point on TCA exterior wall.

NOTE:
Three temperature sensors shall be mounted on the exterior wall as shown in Figure 6. The average temperature is to be used only when 700 F is not exceeded by the TCA.

PREPARED BY: E. Adams	DATE 4/15/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE 4/17	4-18-64			

FORM 608-B-38 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE ELECTRICAL SCHEMATIC TEST NO. 207510-401 SHEET 157 OF 171

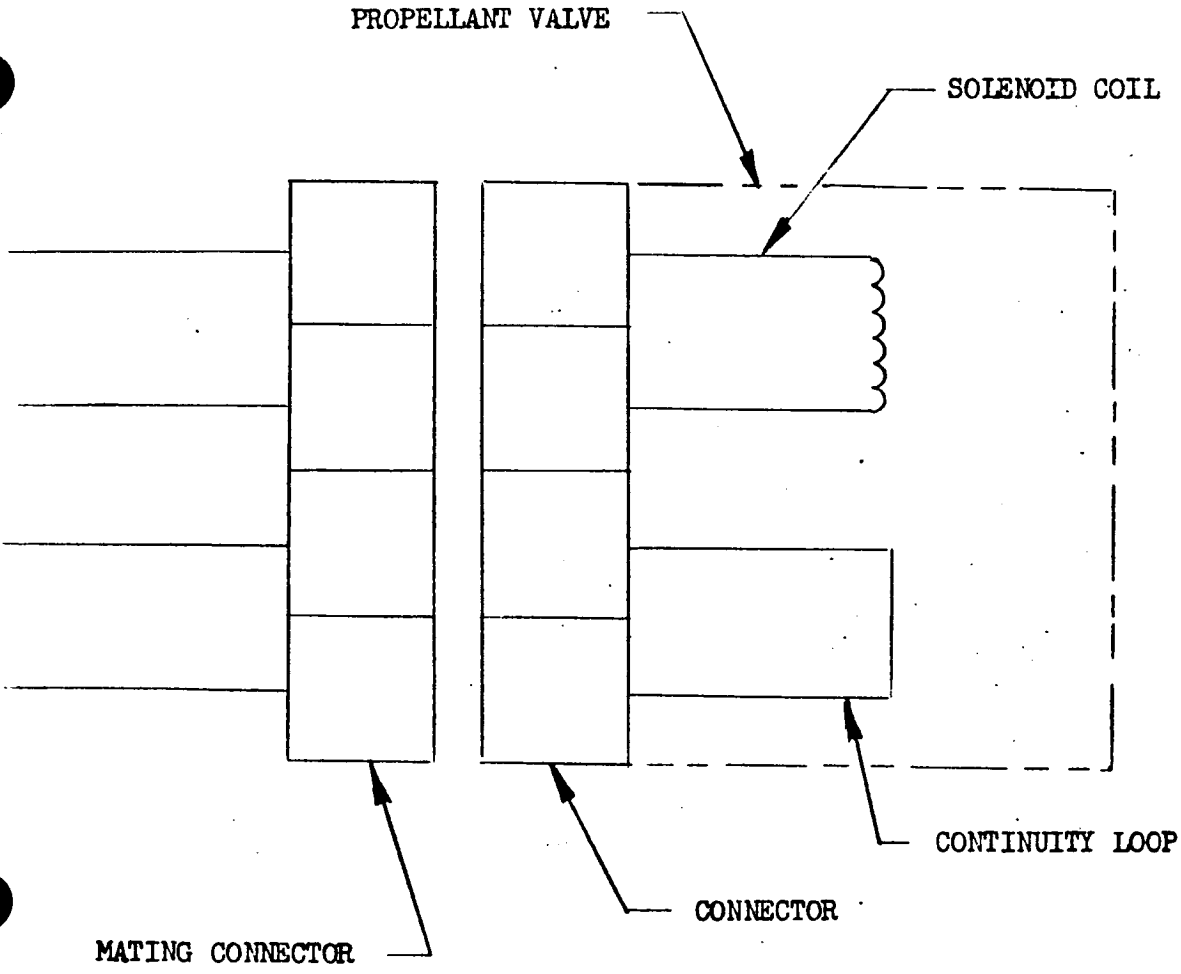


FIGURE 1

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PROPELLANT VALVE PROOF PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST PRESSURE AND LEAKAGE TEST NO 207510-101 SHEET 158 OF 171

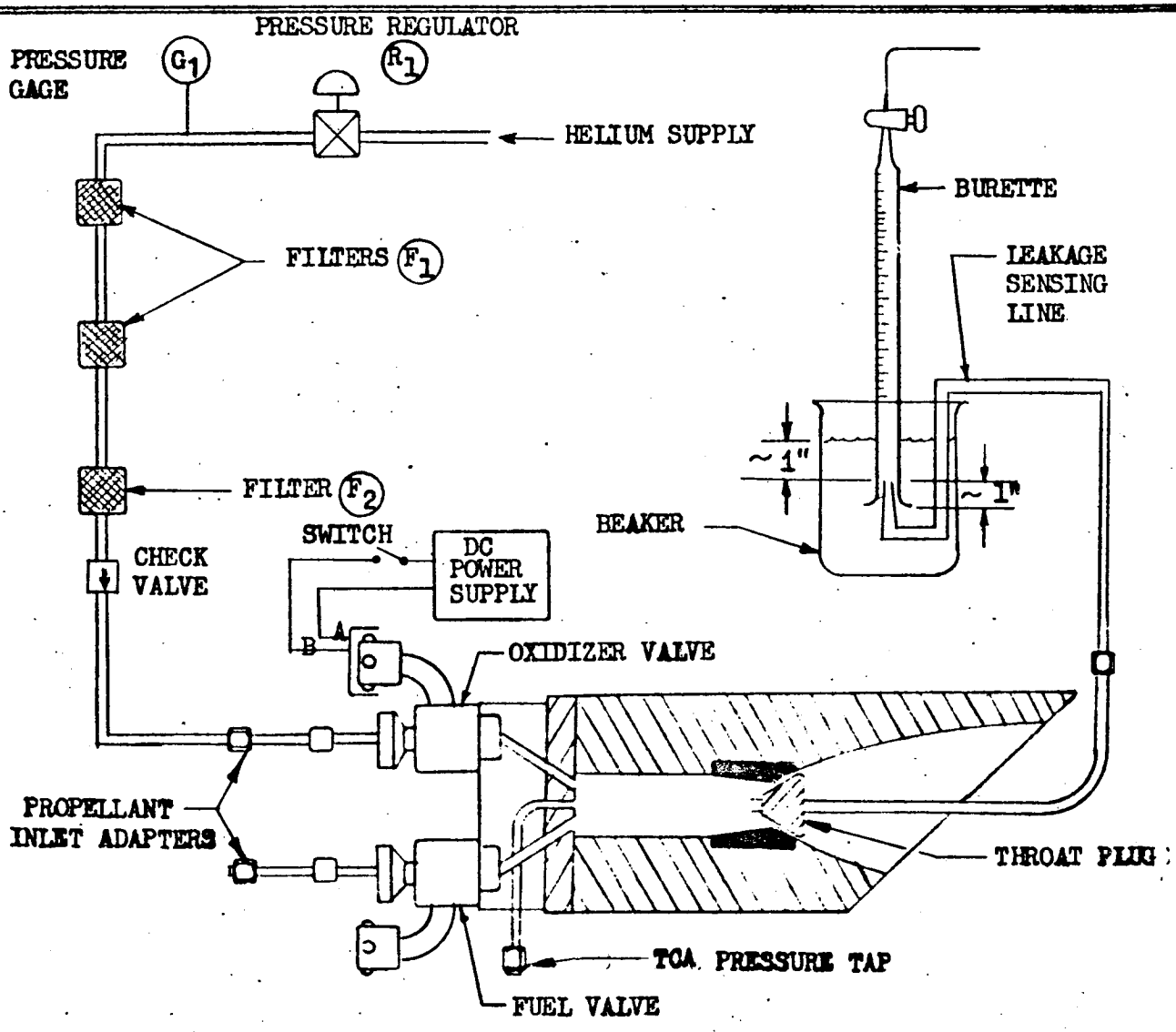


FIGURE 2

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST CHAMBER PROOF PRESSURE AND LEAKAGE TEST NO 207510-401 SHEET 159 OF 171

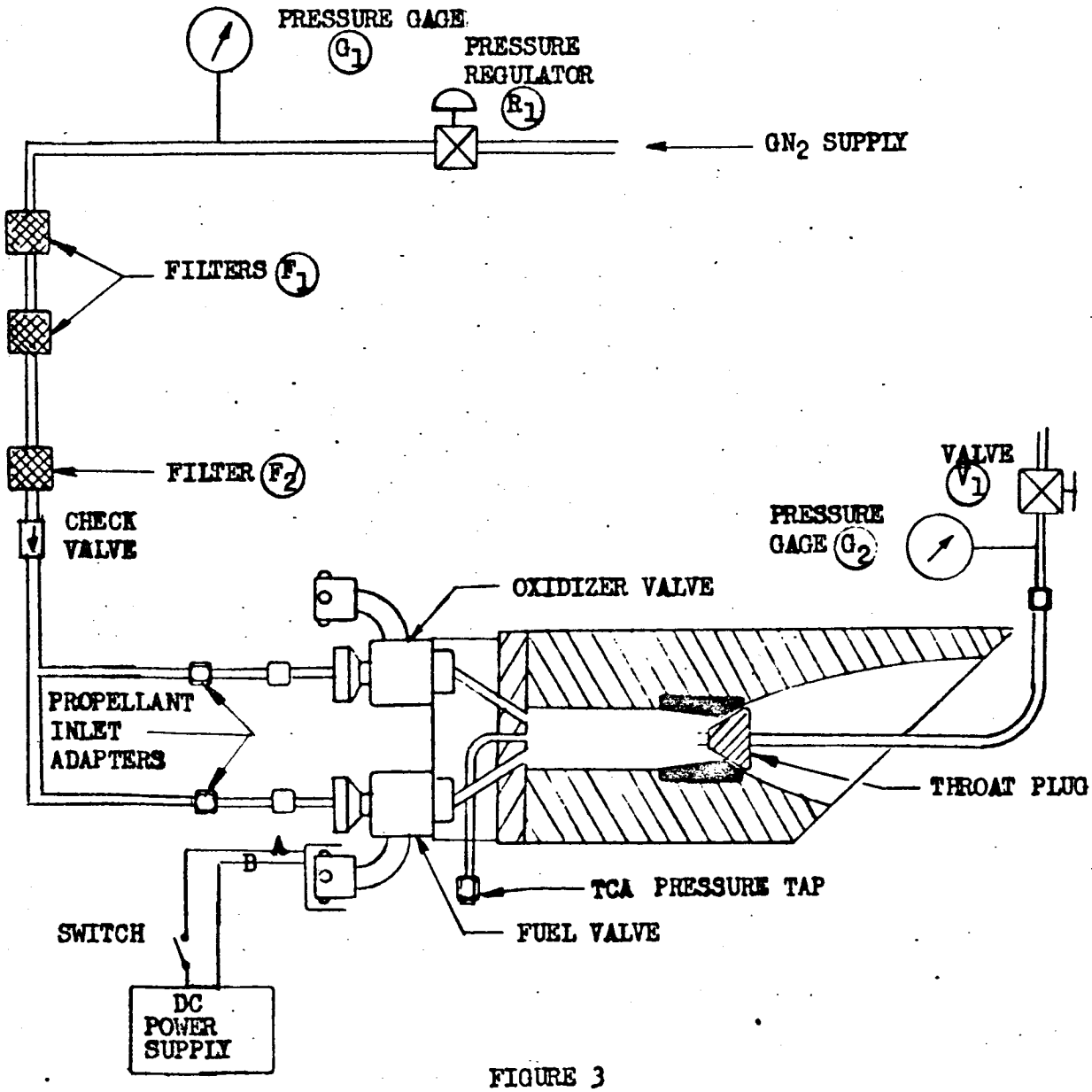


FIGURE 3

FORM 603-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 207510-401 SHEET 160 OF 171

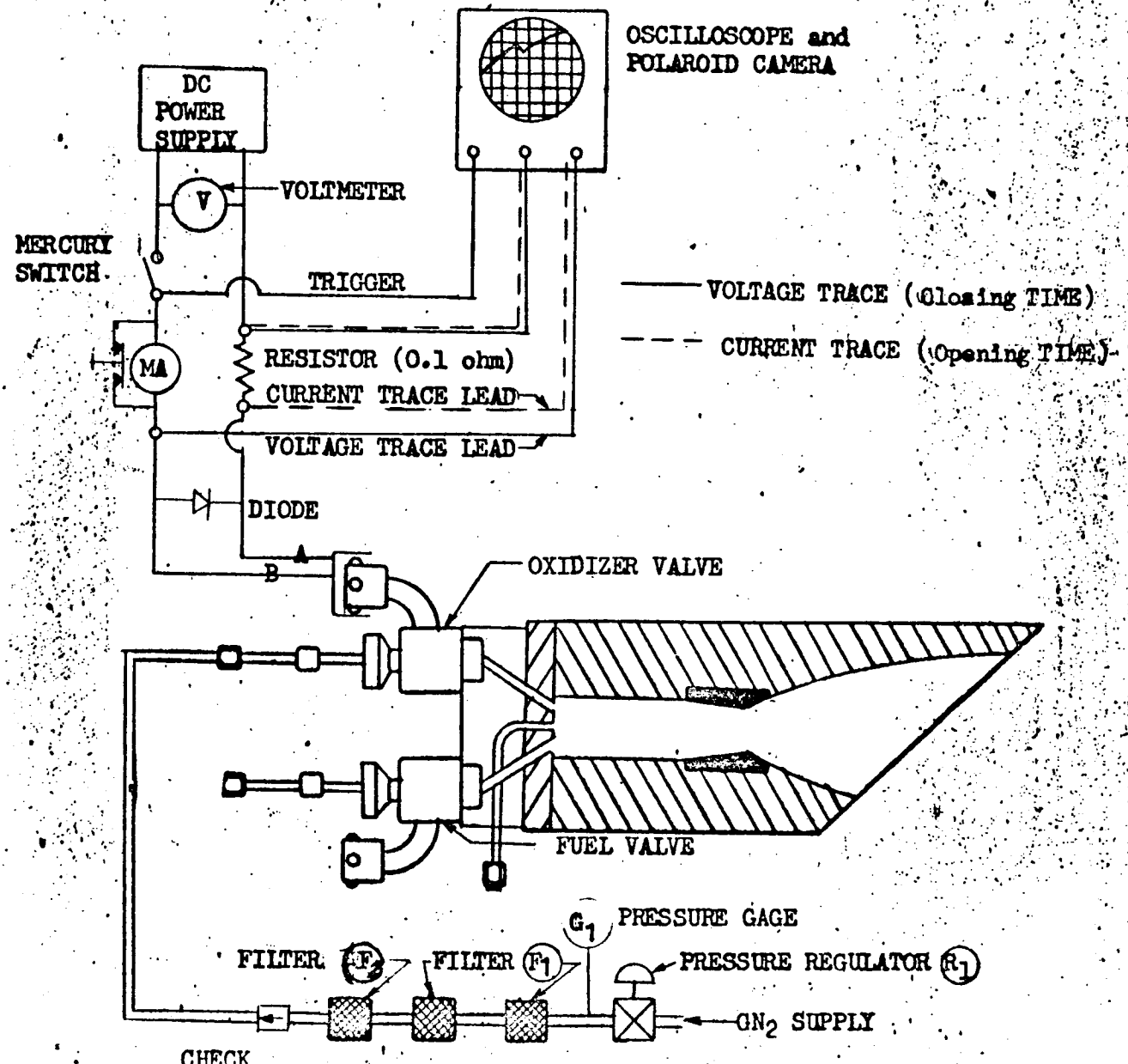
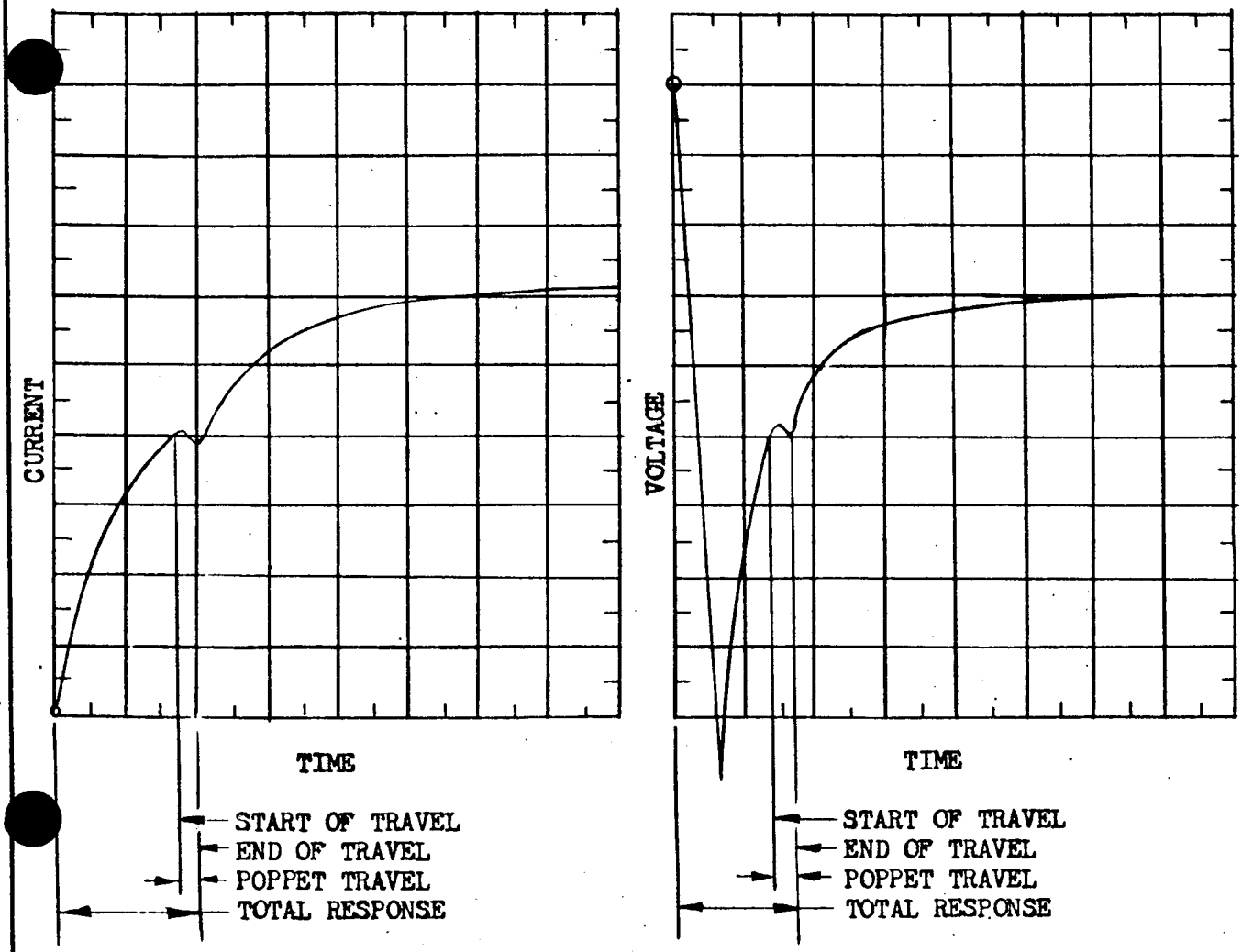


FIGURE 4

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO 207510-401 SHEET 161 OF 171



VOLTAGE AND CURRENT TRACES

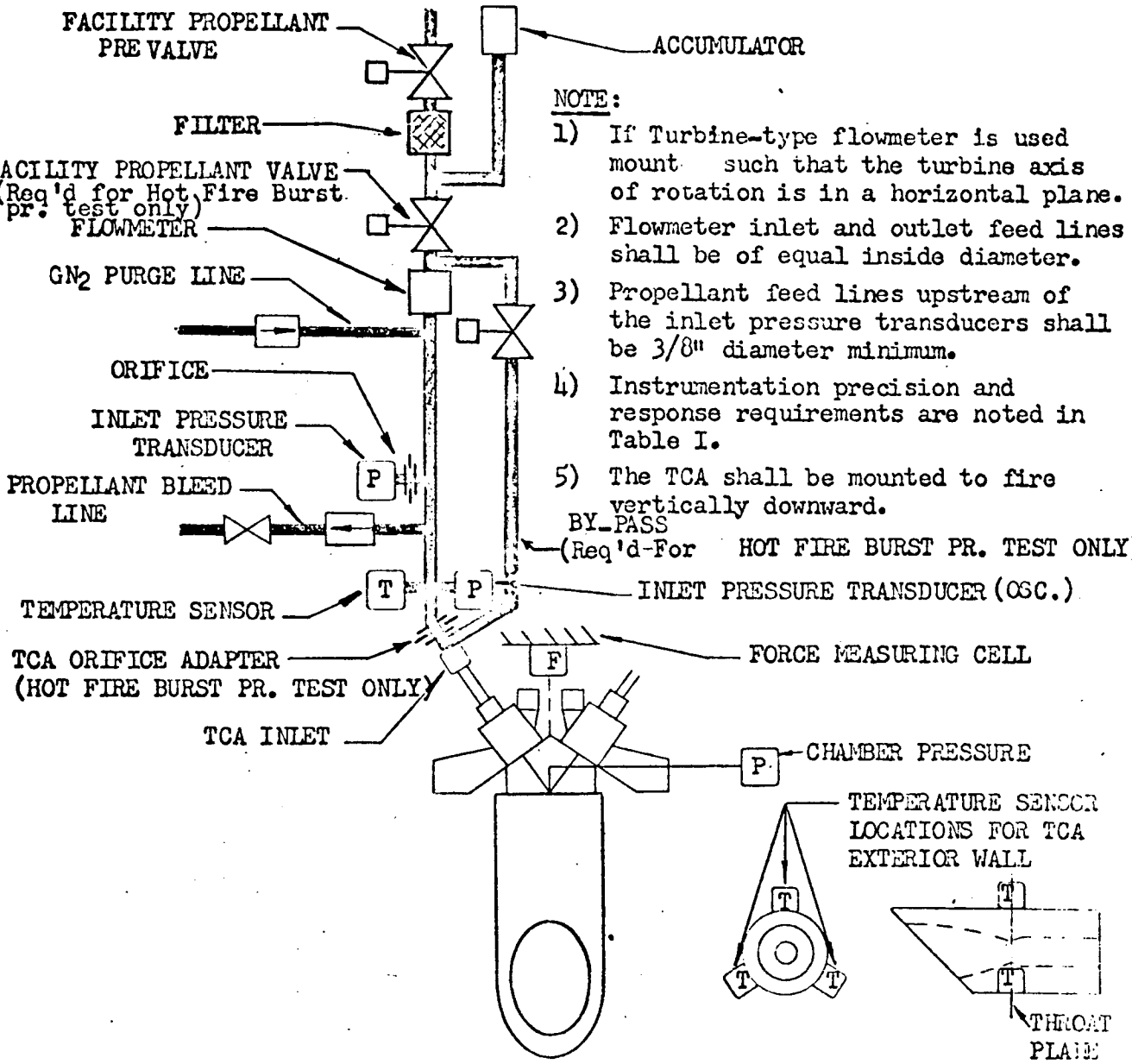
FIGURE 5

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY- 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT FEED SYSTEM TEST NO. 207510-401 SHEET 162 OF 171



NOTE:

1) If Turbine-type flowmeter is used mount such that the turbine axis of rotation is in a horizontal plane. B
2) Flowmeter inlet and outlet feed lines shall be of equal inside diameter. C
3) Propellant feed lines upstream of the inlet pressure transducers shall be 3/8" diameter minimum.
4) Instrumentation precision and response requirements are noted in Table I. A
5) The TCA shall be mounted to fire vertically downward. A

TCA PROPELLANT FEED SYSTEM SCHEMATIC

FIGURE 6

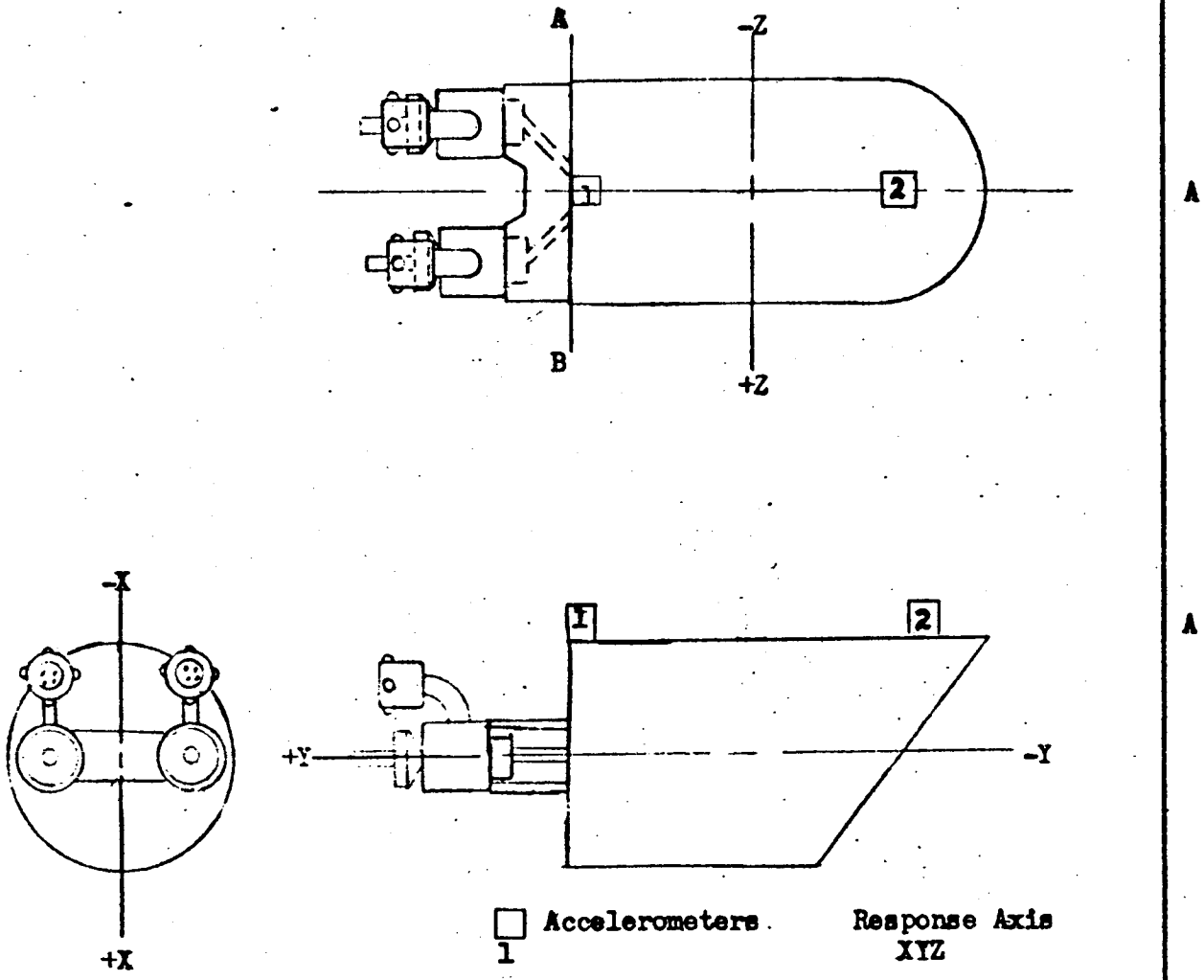
FORM 608-B-37 NEW 6-63

Revision C J. D. Mangels Dated 10/19/64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST VIBRATION AND SHOCK TEST NO 207510-401 163 171 SHEET ___ OF ___



Accelerometers	Response Axis
1	XYZ
2	XYZ

FIGURE 7

FORM COE-8-31 NEW 6-63

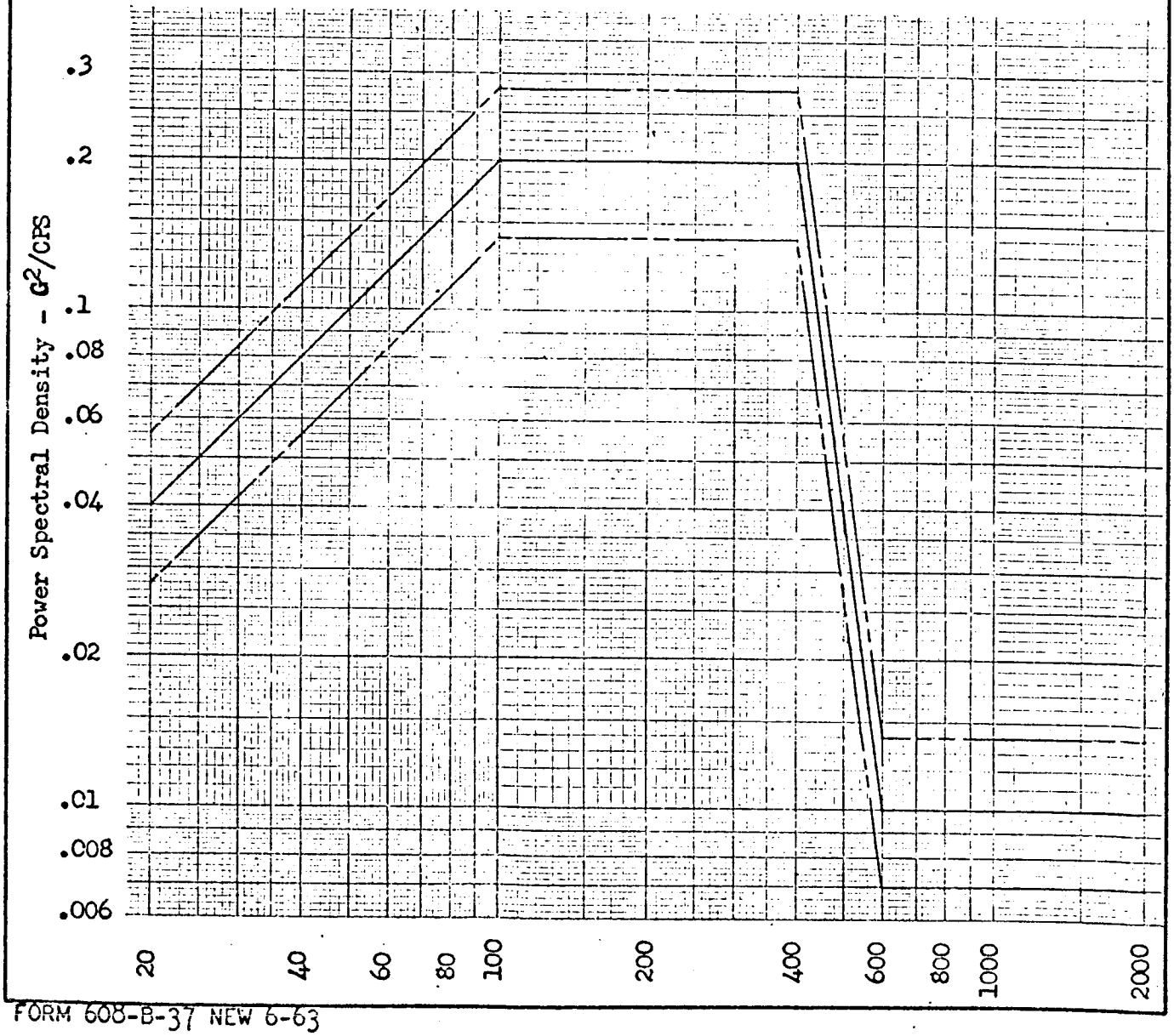
REVISION A/ D. Mangeno Dated 8-31-64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST RANDOM VIBRATION TEST NO. 207510-401 SHEET 164 OF 171



FORM 608-B-37 NEW 6-63

R-15019-2

FREQUENCY - CPS

FIGURE 8

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-475 / NAA 207510-21 -401

NAME OF TEST PROPELLANT VALVE SERVICE LIFE TEST NO 207510 SHEET 165 OF 171

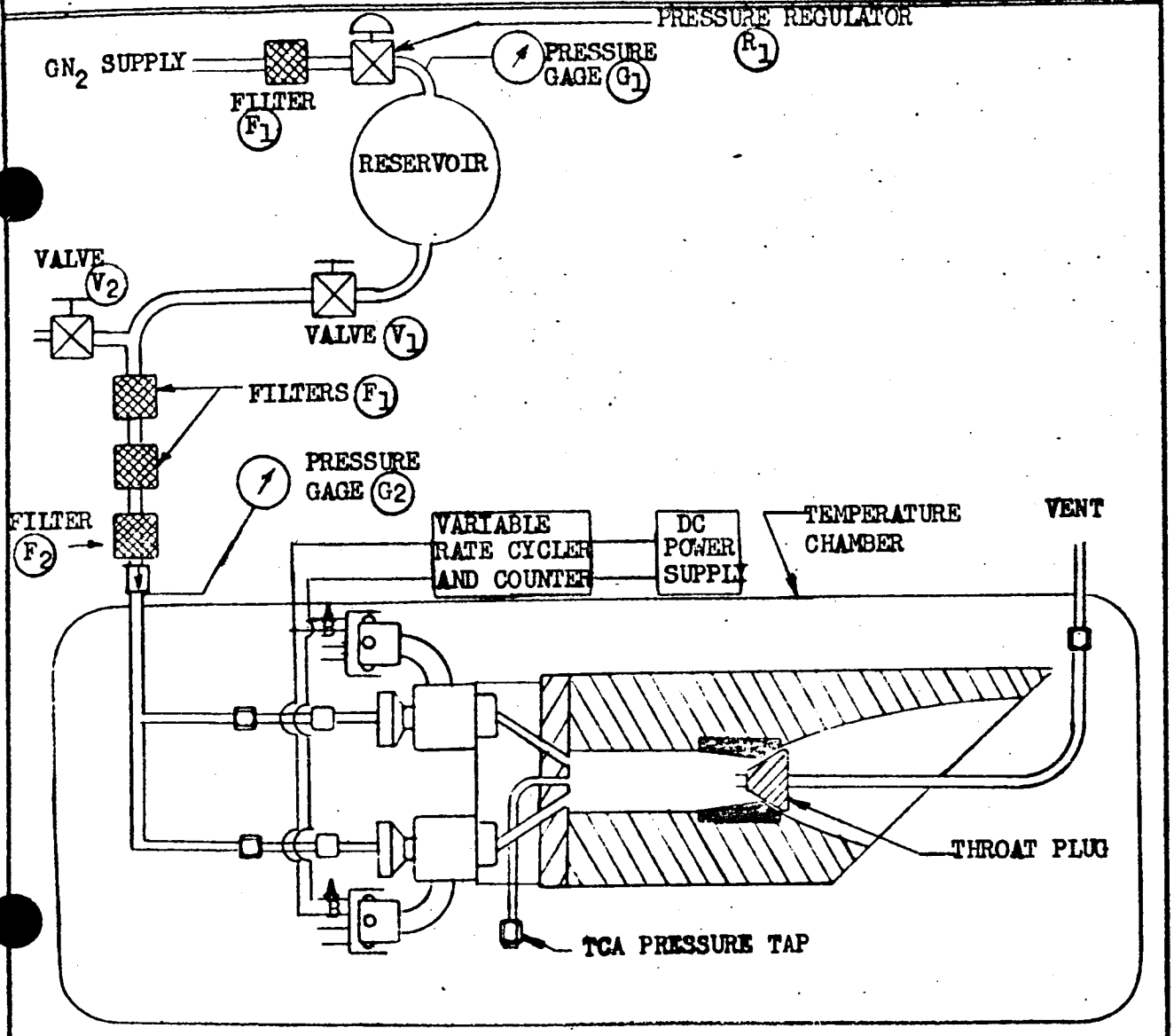


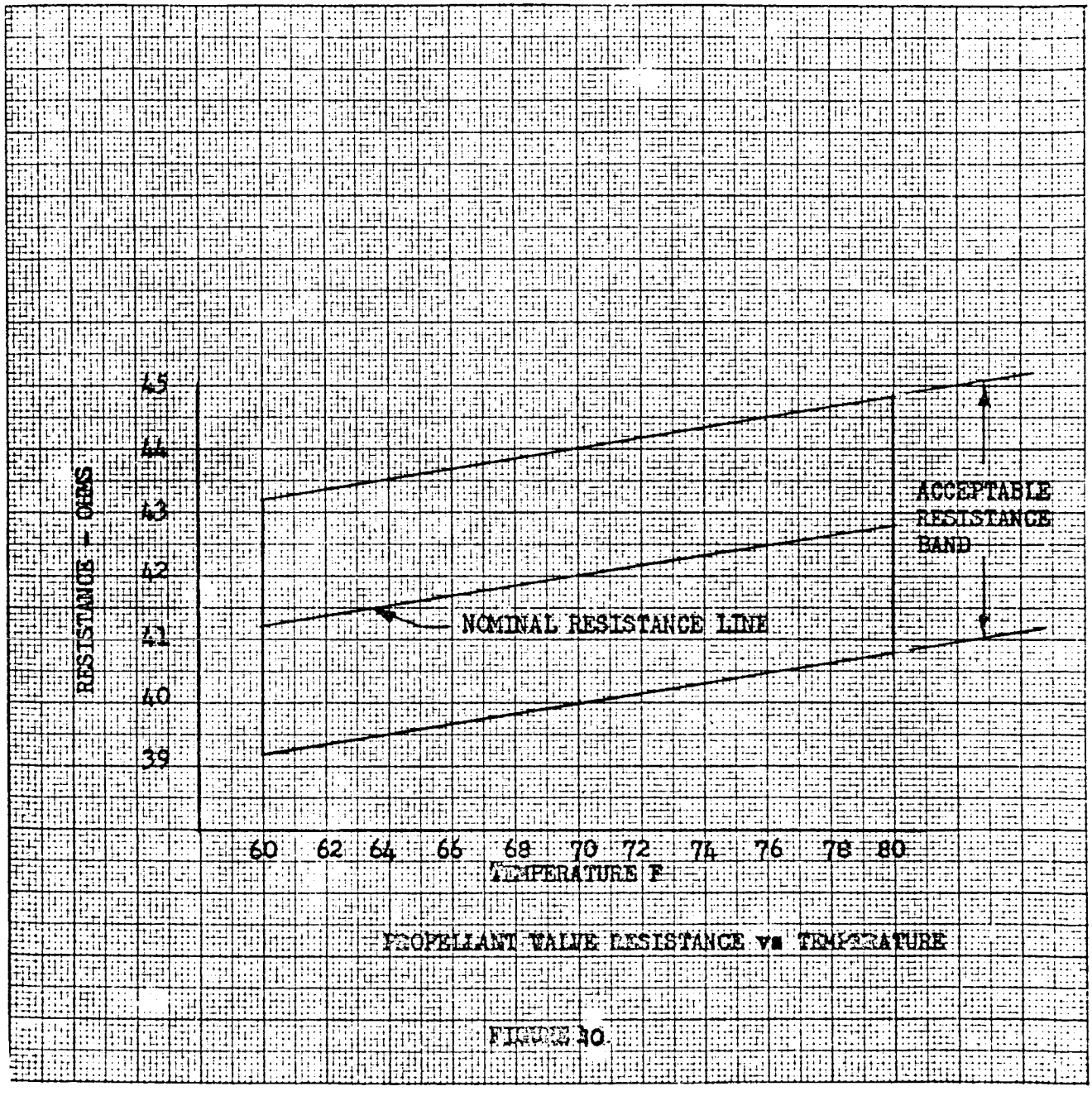
FIGURE 9

FORM 605-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO. 207510-401 SHEET 166 OF 171



PROPELLANT VALVE RESISTANCE vs TEMPERATURE

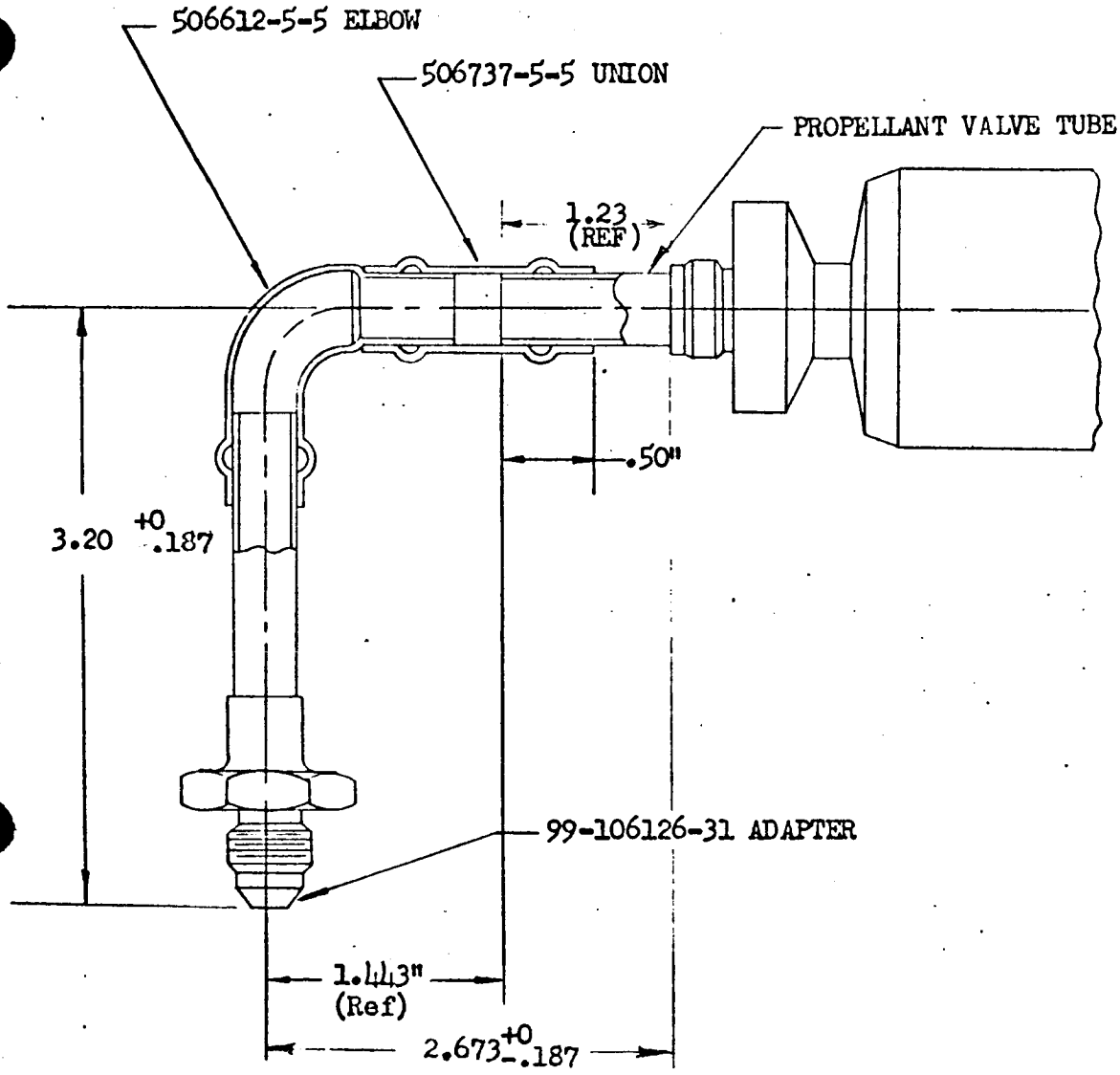
FIGURE 30.

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 207510-101 SHEET 167 OF 171



PROPELLANT VALVE INLET ADAPTER

FIGURE 11-3

FORM 608-B-37 NEW 6-63

REVISION A Dated 9-1-64

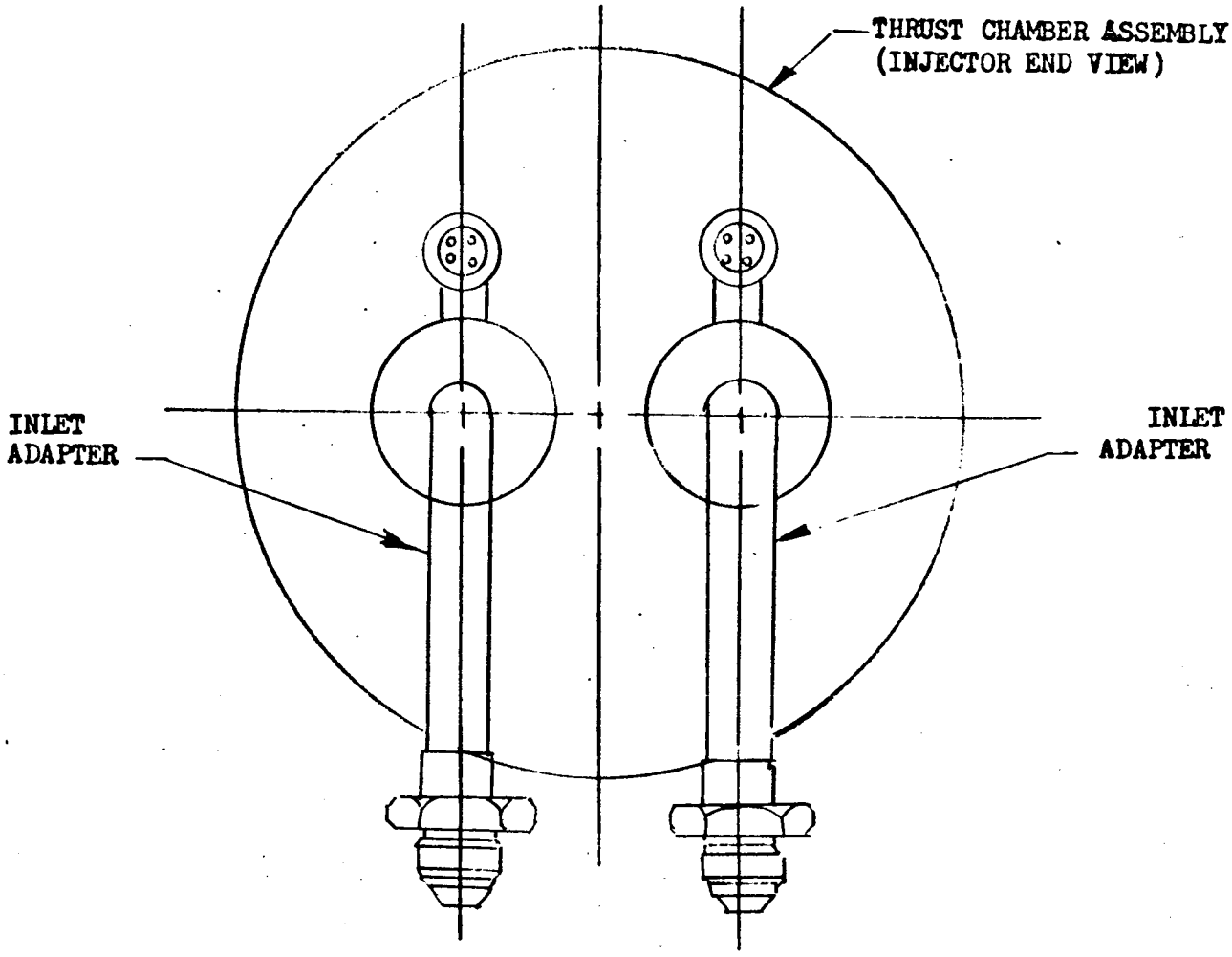
R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 207510-401 SHEET 168 OF 171

A



PROPELLANT VALVE INLET ADAPTER ORIENTATION
(FOR THRUST VECTOR TEST ONLY)

FIGURE 11A

FORM 608-B-37 NEW 6-63

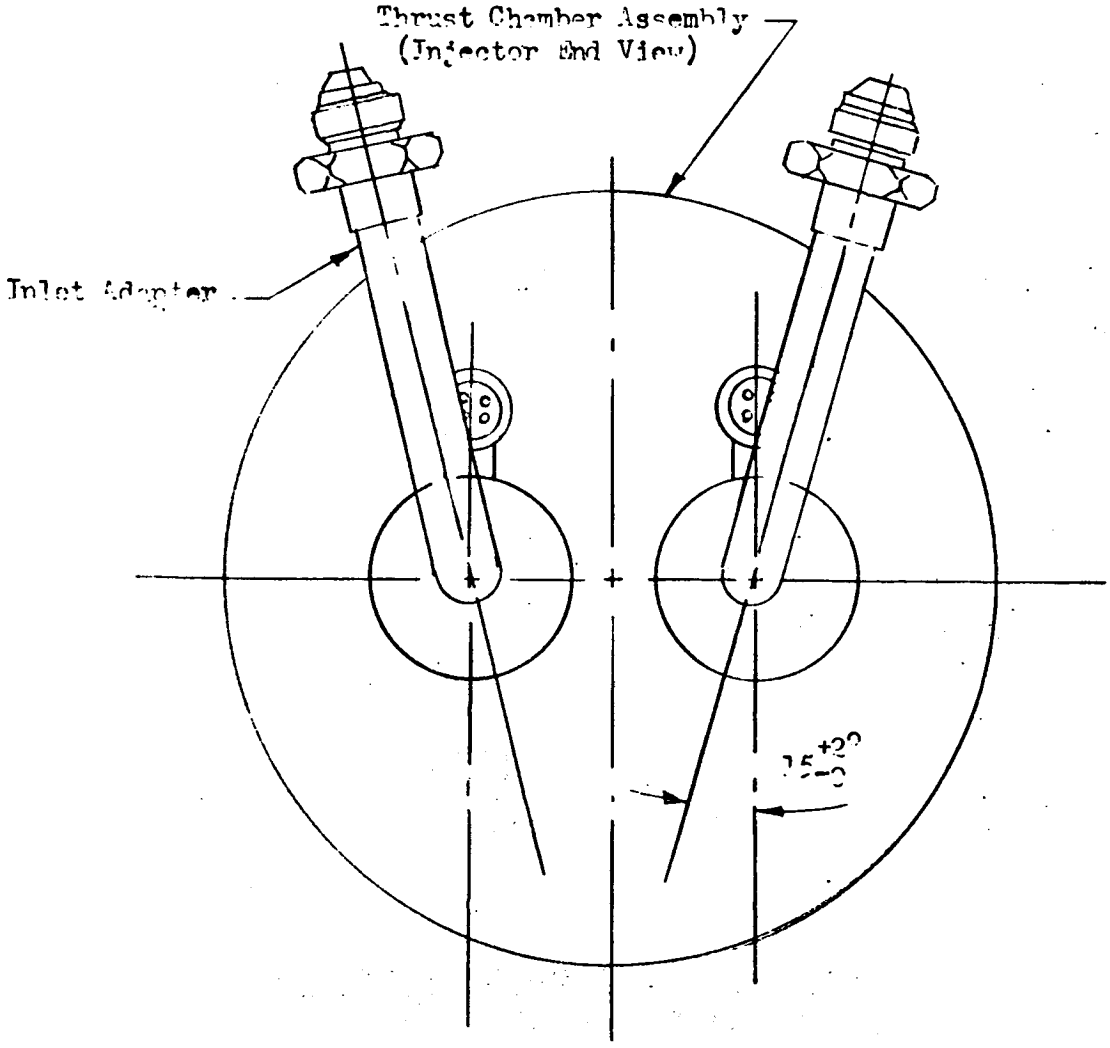
Rev. A J. D. Morrison dated 10-6-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST COMPONENT TEST MODIFICATION TEST NO. 207510-401 SHEET 168 OF 171

A



PROPELLANT VALVE INLET ADAPTER ORIENTATION

FIGURE 11B

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 85# PART NO. { MAC 52-52701-275 / NAA 207510-21 }

NAME OF TEST THRUST PULSE PARAMETERS TEST NO. 207510-401 SHEET 169 OF 171

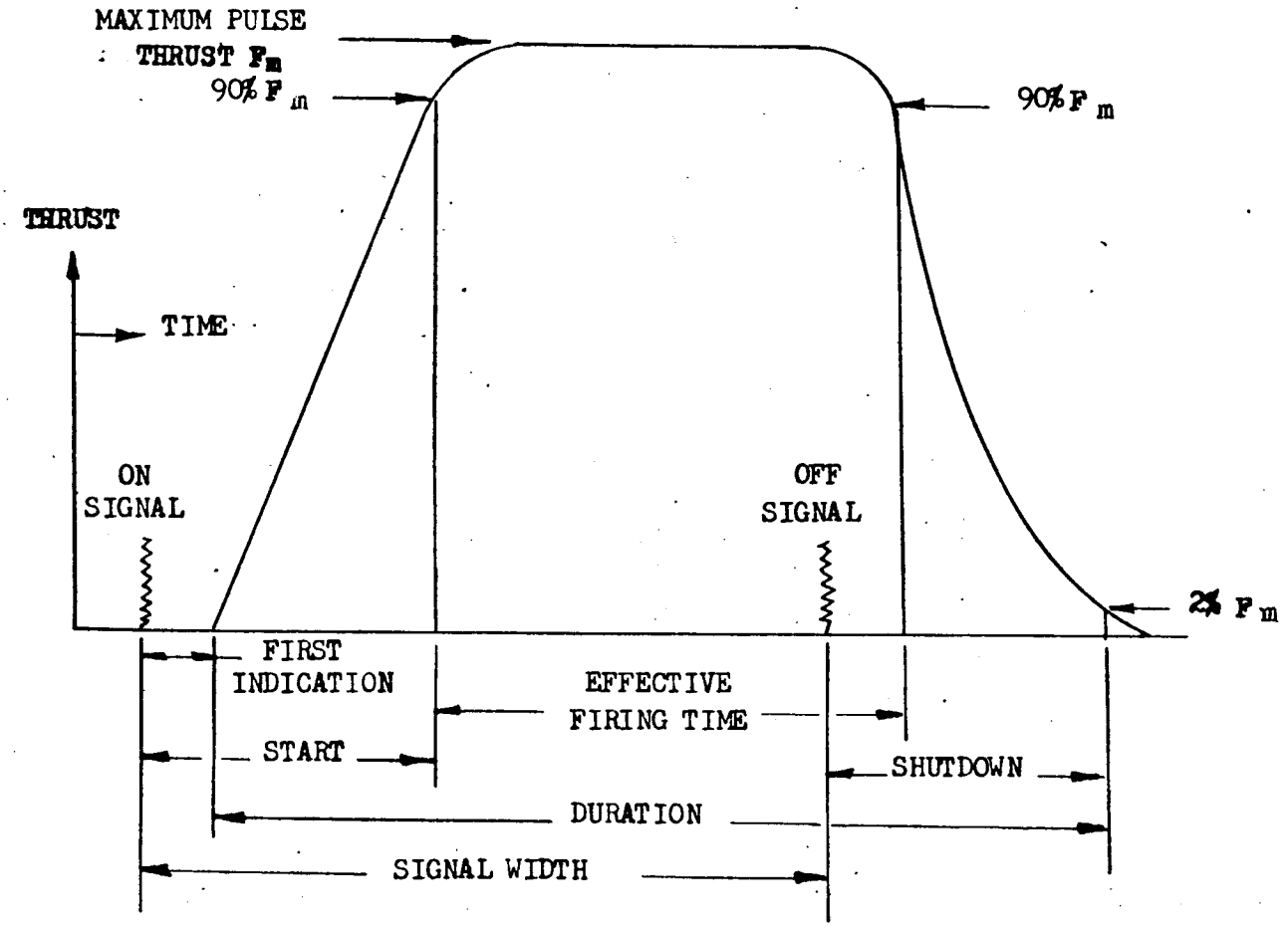


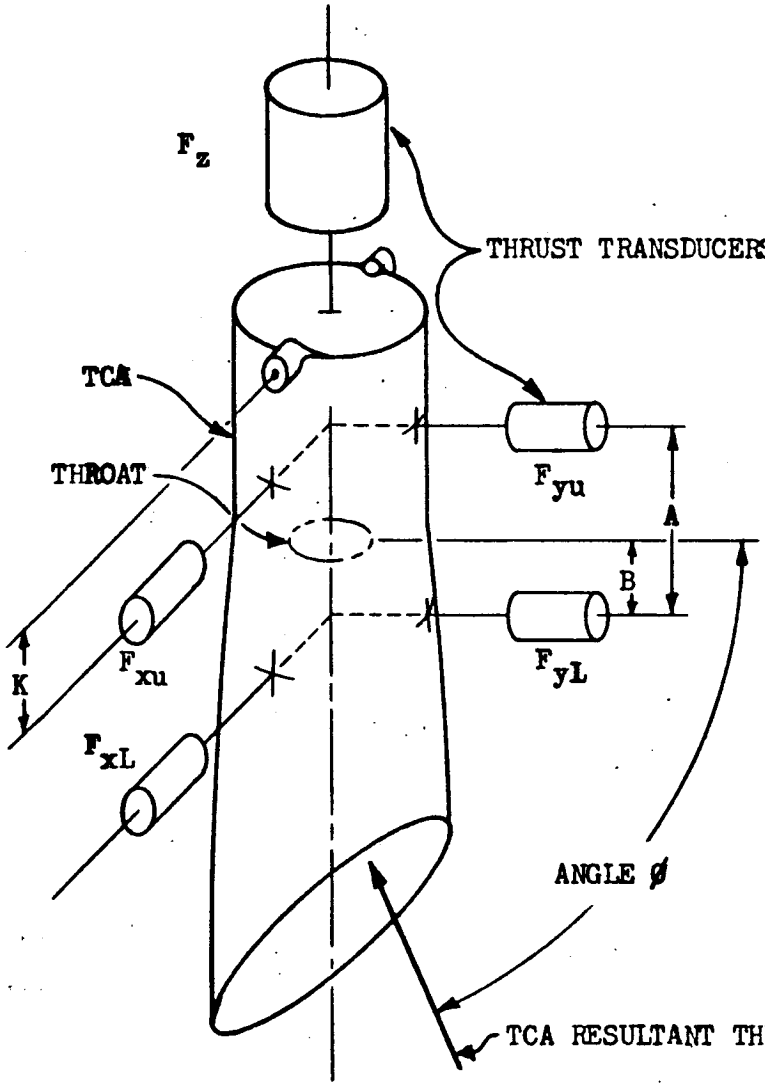
FIGURE 1.2

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST THRUST VECTOR TEST NO. 207510-401 SHEET 170 OF 171



NOTE: F_{xL} shall consist of two load cells to resist TCA torque and their electrical outputs shall be summed.

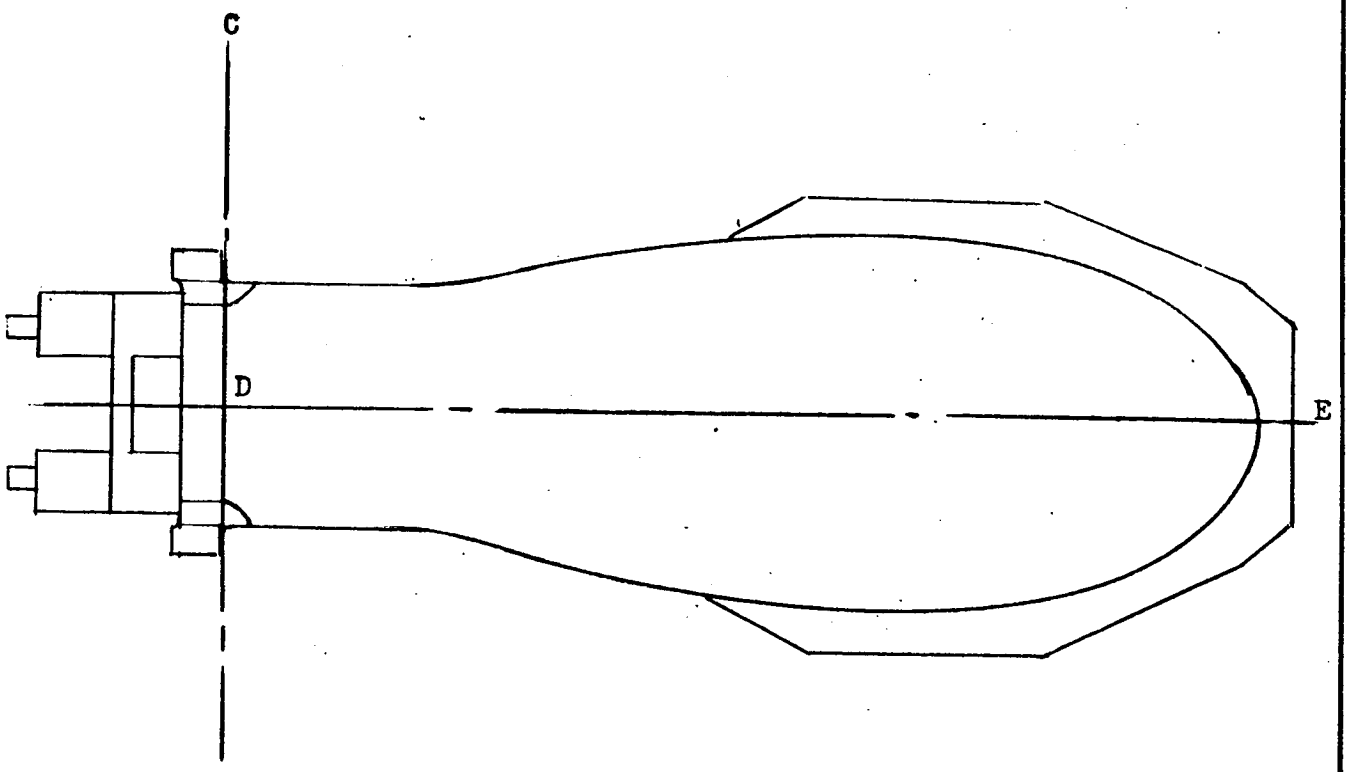
FIGURE 13

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -85# PART NO. { MAC 52-52701-275 / NAA 207510-21

NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 207510-401 SHEET 171 OF 171



SECTIONING DIAGRAM

FIGURE 14

FORM 608-B-37 NEW 6-63

R-15019-2